# Compressed Air Magazine

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*AIR-DRIVEN EQUIPMENT HAVE MADE POSSIBLE THE BUILDING OF WONDERFUL ROADS THROUGH THE CANADIAN ROCKIES*



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VOL. XXIX, NO. IX

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# Cutting the Cost of Cleaning Fabrics

## The Result of Much Experience and the Selection Finally of An Oil-Engine Power Plant

By ROBERT G. SKERRETT

CLEANING and dyeing of wearing apparel has given birth to an industry of considerable magnitude—not to mention importance. Through this agency, soiled, faded, or somewhat shabby articles of clothing can be made spick and span again and suitable for a further period of satisfying service. We all know what the dyer and the cleaner can do, but there are not many of us with an understanding of how this refurbishing or rehabilitating work is done. The purpose of this article, among other things, is to give the reader an idea of the present-day facilities and processes employed in a modern establishment of this sort.

**LOW-PRICED power and how to obtain it. This is the puzzling question confronting the managers of many plants. The solution of this problem is of intense interest to hundreds of responsible officials.**

**The story we have to tell describes how a good-sized establishment engaged in a special line of work has, during its long existence, run the whole gamut of prime movers—starting with steam and ending up with an oil engine.**

**What these people have learned should be of value to others as an index of what engineering skill has accomplished of late. Their difficulties may be like yours: anyway, the article records a long step forward in mechanical progress.**

To appreciate something of the evolution which has taken place in this particular field of endeavor—in which mechanical appliances have largely supplanted the handwork of the past—we are going to sketch the growth of a company which had its modest beginnings in Wilmington, Del., 88 years ago. This, in part, will help to explain the business position now enjoyed by this firm and the excellence of the work done by it.

Way back in 1836, a family of French extraction organized a dyeing and cleaning house in Wilmington. They came of a people that had for a goodly while been noted for their skill in coloring and in cleaning textiles of all sorts and range of ruggedness and delicacy. They met an existing need, and they did their work so well that their customers multiplied apace. In the course of time the business passed into the hands of a younger branch of the family; and, much enlarged, it was moved to Philadelphia in 1876 where it became known under the firm name of A. F. Bornot Brothers Company.

In passing, let it be said that cleaning and dyeing was for some decades more or less of a seasonal character; and, because of the means employed, clothing represented the great bulk of the fabrics handled. Nowadays, the industry has plenty to keep it busy throughout the twelve months; and blankets, curtains, hangings, carpets, rugs, and various sorts of upholstery are among the household effects that undergo renovation.

The very diversity of the articles now dealt with by the dyer and cleaner have gradually led to the devising and perfecting of machines and other equipment which make it practicable to do good work speedily and effectually. And the fact that these facilities are today essential should make the customer hesitate before turning his belongings over to persons engaged in the business but not similarly equipped. Before we finish our story it will be evident that compressed air has a number of useful and extremely serviceable functions to perform at different stages in the treatment of various articles of dress or household appointments.

In the present-day operations associated with so-called dry cleaning—which, by the way, is not a dry process but a decidedly wet one—benzine is the primary cleansing fluid, and benzine is a very dangerous combustible unless it is controlled or handled with the utmost care and by experienced workers. Furthermore, steam, hot water, and much motive energy are required at one stage or another of the activities of such a plant, and these involve the consumption of fuel and the generation of heat which might occasion serious trouble or disaster in the absence of suitable precautionary measures and ceaseless vigilance. These facts are mentioned as evidence of the way in which the Bornot establishment is run and how it meets the requirements of municipal ordinances, which are extremely exacting in the cases of industries or businesses that might prove a menace to neighboring life and property. The Bornot plant is situated in the very heart of a populous section of the city principally given over to dwellings.

The articles of dress, fabrics, or what not, that are to be renovated are placed in the perforated revolving drums of enclosed dry-cleaning machines. Into these machines is admitted a suitable quantity of benzine, after which they are sealed and their drums set in motion. The resulting agitation causes the benzine to work through and through the textiles and thus to extract from them the dirt or grime held by them. The fumes given off by the benzine are withdrawn and carried to a condenser, and in this manner benzine is recovered for re-use. This closed system, which utilizes the vacuum pump, keeps the loss of benzine by vaporization well within a range of from 2 to 10 per cent., depending upon circumstances. Most of this loss occurs while the machines are open either to receive or to permit the withdrawal of goods. All dirty benzine is run through a still and thus cleaned so that it will be fit again for service. The still is heated by steam and the condensing coils are cooled by circulating water.

As might be expected, much water is required daily in the plant, and something like 25,000 gallons is used every 24 hours for rinsing and bleaching. The hard water employed in this way is obtained from a 250-foot well, from which it is raised by an air lift. This water is stored in a tank on the fourth floor of the building, and from there it is distributed by gravity to the different service points.

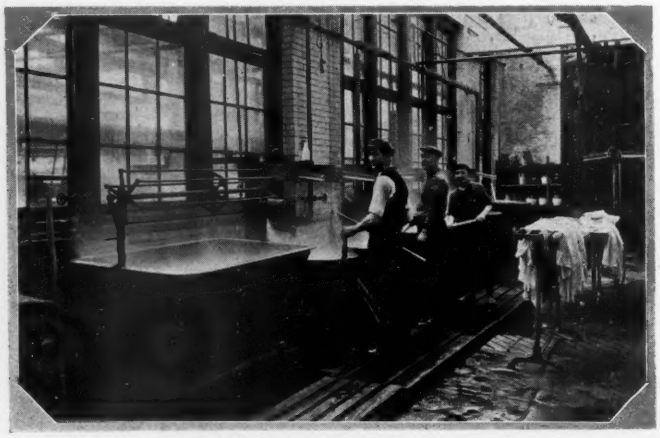
There is a very common but erroneous belief that dry cleaning, in itself, is sufficient to get rid of all spots, etc.; but this is not true even though benzine is a decidedly effective solvent and cleaning medium. Sugary stains, the marks of perspiration, and some other blemishes per-

sist after the fabrics have been run through the dry-cleaning machines; and these spots, discolorations, and the like can be disposed of only by the judicious or expert use of soap and water. Right here is one of the differences between the work of a first-class and a mediocre cleaner. The sort of soap used has much to do with the result and varies according to the kind of material and the nature of the stain. Herein lies one of the secrets of the trade.

At times, the chemical action of certain fluids will cause discolorations which cannot be removed merely by cleaning, and it is at this point that the cunning of the dyer comes into play. It may be necessary to dip and to dye the whole of the garment, but its salvation may depend upon the skilful employment of another process—that known as "speck dyeing." This consists in atomizing color onto the textile by means of compressed air; and it can be done so expertly that the discolored area can be retinted to harmonize with the original hue of the material. We have here an adaptation of the air brush; and much depends upon the manual dexterity and the keen eye for color of the artisan wielding it.

With the cleaning or dyeing done, the next thing is to press the goods. At Bornot's this is done well-nigh uniformly by electrically heated irons. In the case of Renaissance-lace curtains, for example, which are heavy and stiff, a somewhat modified treatment is required in the finishing department. Instead of electric irons, small air-driven hammers—with rounded, heated heads—are utilized to flatten the patterns.

**Part of a battery of dry-cleaning machines being cleaned with compressed air.**

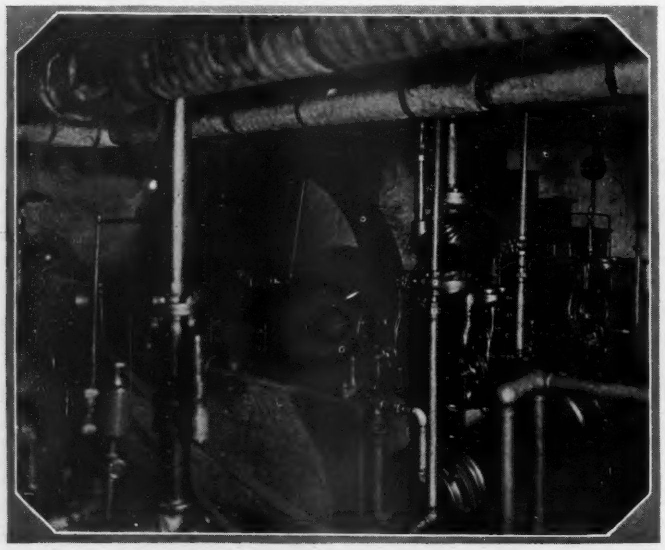


**These are steam-heated dye kettles used for the dipping of small articles.**

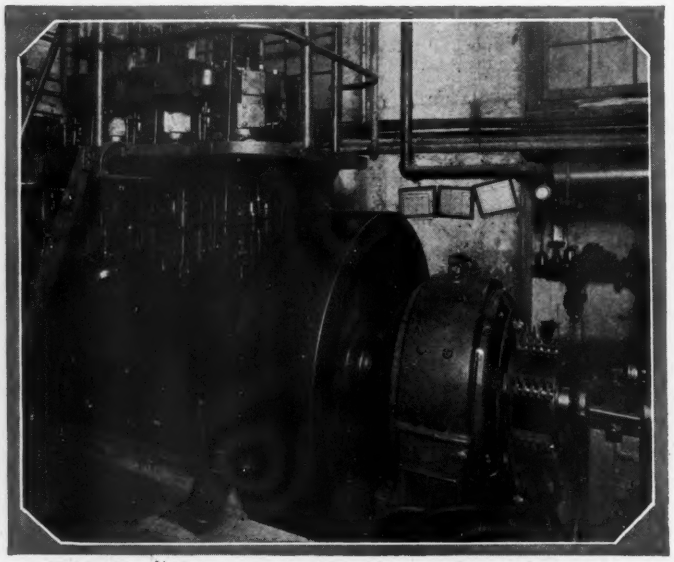
Interesting as it might be to trace step by step the various ways in which soiled neckties, waists, waistcoats, slippers, gloves, other wearing apparel of many kinds, furs, the interior upholstering of automobiles, etc., etc., are cleaned and made fit for another period of service, this cannot be done because of lack of space. However, we can take a single example of the more rugged textiles treated—that is, the cleaning and steaming of carpets or rugs. In place of the time-honored procedure of beating and sweeping to remove accumulated dust and dirt, certain machines at the Bornot establishment do these things more rapidly and more completely than is ordinarily practicable by the hand method. One of our illustrations shows a rug being dealt with by such an apparatus.

Within the machine is an axial shaft to which is attached a multiplicity of looped straps which are whirled around as the shaft is turned by a motor. After one edge of the rug has been fed into the wide mouth of the machine, these whirling straps serve to draw the rug in and to beat it energetically the while. The dust is withdrawn by suction blowers. This prevents the pollution of the atmosphere breathed by the workers. In short, it is a sanitary operation. From the carpet beater the rug is carried to a perforated grid connected on the underside with the blower exhaust system. The rug is spread upon this grid and subjected to further cleaning by means of a sweeper that looks like a vacuum cleaner but which, in fact, blows a stream of compressed air right through the textile. In this way, any remaining dust is forcibly expelled downward and outward.

Having been thoroughly dusted, the carpet is now ready to be steamed. Again, it is laid upon a grid or perforated table beneath which there are two series of steam pipes or coils. One of these coils is perforated and sends the steam upward through the fabric. The steaming removes wrinkles and brings up the nap. While still wet the rug is fastened down, the escaping steam is shut off, and the heating coils are brought into play to dry it. With the drying completed, the floor covering is rolled up and made ready to be shipped to the customer.



**Electrically driven, 2-stage compressor that maintains a pressure of 90 pounds in the air line throughout the plant.**



**Oil engine of 150 H.P. which has greatly lowered the cost of generating electricity used in the establishment in many ways.**

It is claimed that the house of Bornot is the largest one of its kind in the United States doing business in a single city. Some warrant is given for this in the bulk figures of certain articles handled by the establishment annually. In the course of a year, it deals with 60,000 suits for men and women, 30,000 silk dresses, 35,000 blankets, 50,000 pairs of curtains, between 25,000 and 30,000 pairs of portières, and 125,000 yards of carpets and rugs. There are, of course, numerous other things that are dyed and cleaned, but these need not be detailed. With good reason, the management boasts that all work is done in a sanitary way in a sanitary plant; and a visit will verify this.

Aside from the uses already mentioned, compressed air is employed for blowing out or cleaning the dry-cleaning machines; for pumping or distributing the benzine; for general house cleaning throughout the plant; for spray painting; for cleaning electric motors; for blowing out the tubes of the two boilers; and for operating air-driven tools whenever it is necessary to cut into concrete, drill holes through walls, and to perform similar construction or repair tasks. Air for these purposes is furnished at a pressure of 90 pounds by an Imperial XB-2, 14 and 9x12-inch, 2-stage compressor driven by belt from a 79-H.P. electric motor, operated by current generated on the premises.

In different departments of the dyeing and cleaning work a considerable volume of steam is needed; and to meet this demand there are two oil-fired boilers rated, respectively, at 275 and 325 H.P. This fact is interesting, especially when we realize that the company depends upon an oil engine for its prime mover. In other words, experience has shown the management that it would cost them a good deal more to have a steam prime mover and to utilize the exhaust for the services now taken care of by the boilers directly.

Originally, the plant was equipped with a steam engine which, in combination with the other services, required the burning daily of from five to six tons of coal in the summer season and from six to seven tons of that fuel during the winter months. Circumstances were such that the coal had to be delivered three times every 24 hours. The steam engine was supplanted in time by a motor-generator set—operating current being purchased. With the demand for greater economy, the motor-generator set was abandoned and two gas engines were installed instead. One of these engines was of 75 H.P. and the other of 125 H.P.; and gas to run them was obtained from an associate producer plant. The producer equipment used Lykens Valley white-ash pea. Subsequently the producer was scrapped and bought gas was relied upon. Again the question of costs compelled a change; and last year the company procured a 150-H.P. Ingersoll-Rand oil engine. This engine, according to the plant engineer, is able to handle loads which the two gas engines in combination somehow could not take care of. It is direct connected to a General Electric 100-kilowatt generator, which furnishes current at 125 volts at full load when making 277 revolutions a minute. Electricity is utilized extensively throughout the establishment for lighting, for operating various machines, for heating irons, etc., etc.

By way of comparison, we are informed that


**Fig. 1—Clothes that have been cleaned hung up for drying.**
**Fig. 2—Ironing renovated hangings.**
**Fig. 3—In the pressing room where garments are handled.**
**Fig. 4—An array of finished work ready to be sent to customers.**



**Oval—Carpet-beating machine which removes most of the dust. This work is done by a revolving shaft which whirls loops of belting.**

**Right—The last of the dust is blown downward and out of the fabric by a compressed-air cleaner. The dust passes through the metal grid and is carried off by a suction blower.**

**Left—Steaming and drying table upon which a carpet is first steamed to raise the nap and then stretched so that it will not shrink during drying.**

the motor-generator set cost from $2.25 to $2.50 an hour to run on current from an outside source. The 125-H.P. gas engine, when operated recently for three hours on gas drawn from a local plant, consumed $11.05 worth of gas in that period. The 150-H.P. oil engine, on the other hand, requires about eight gallons of fuel oil an hour; and, at 5½ cents a gallon, this represents an hourly expenditure of 44 cents. To state the case differently, the motor-generator set cost in purchased current substantially $768 a month, while the oil-engine unit can be run for a like period for $99—that charge including both fuel and lubricating oils.

According to the engineer, only one turn is necessary and then the engine is off and running perfectly. It is started with air at a pressure of approximately 200 pounds, which is held in readiness for this service. Starting air is furnished by a small Ingersoll-Rand vertical compressor. The attitude of the management is one of outstanding satisfaction and conveys the impression that the new prime mover has saved them much trouble and anxiety. As one of the officials expresses it: "The oil engine is always on the job; it requires very little supervision; and it tackles an overload without hesitation. It is a wonderful piece of machinery, and no end of a comfort to us."

## GARAGE OF UNUSUAL DESIGN

GARAGES of large capacity are an urgent necessity in many big cities, especially in those congested places where the question of ground space must be taken into consideration. In this connection, the conversion into a garage of a structure that no longer served its purpose would seem to offer a worth-while suggestion.

In the earlier days of the gas industry, it was the custom in Berlin, Germany, to surround gas holders by brick walls. When a gas tank so protected was thrown out of service, it was decided to transform the shell into a motor garage. The structure is high enough for ten floors; and each floor will be large enough to accommodate comfortably 100 automobiles and 50 motor cycles. The building will be surrounded by a 25-foot helical roadway that will make a complete circuit, at an easy grade, at each level.

## LARGE STEAM-HEATING UNIT PLANNED FOR WASHINGTON

IT IS announced that plans have been completed, under the supervision of the Superintendent of Public Buildings and Grounds, Washington, D. C., for the construction of what is claimed will be the largest steam-heating plant in the world. Oil is to be used exclusively for fuel.

Eleven public buildings will be served, including the Navy and Munitions Building and the Interior Department Building with 3,000 and 1,400 rooms, respectively. An aggregate floor space of 3,400,000 square feet will be heated. It is estimated that 51,000 barrels of oil will be consumed per annum and that 215,000,000 pounds of water will be evaporated. Instead of a land reservoir for oil storage, a 40,000-barrel tanker will be conveniently anchored in the Potomac.

## NEW ELECTRIC METER

A GENEVA instrument concern has developed a quadruple-tariff electricity meter that enables power producers to sell electric current at different prices, according to the hours of the day and also according to the demand for current which, at certain periods, may absorb the total capacity of the generating plant.

This multiple-tariff meter carries two totalizers: one indicating the current consumed in kilowatt-hours, and the other registering automatically in francs, or in other currency, the value corresponding to this classified consumption. The advantages of the meter are twofold: it permits the application of four rates which can be selected and adapted to varying local conditions, and also lessens the amount of bookkeeping for the power company.

# Making Canada's National Parks More Accessible

## Air-driven Tools and Portable Compressors are Playing a Big Part in Building Roads and Doing Other Essential Work

By J. M. WARDLE*

CANADA has long been famous as a vacation land. Being a comparatively new country, with the notable exception of the Province of Quebec, it cannot boast of that historical lore that so charms the visitor in Europe. What it lacks in this respect, however, is more than made up by the endless variety of its many scenic wonders.

Each province, from the Atlantic to the Pacific, is endowed with its own peculiar wealth of natural beauty. The surf-torn coasts, the mist-clad slopes, and the fertile valleys of the maritime provinces; the mighty rivers, the thundering falls, and the wooded hills of Quebec; the Thousand Islands, Niagara, the Great Lakes, and the rich and picturesque gold fields of Ontario; the seas of wheat, the sunken rivers, and the boundless skies and gorgeous sunsets of the prairie provinces; the snow-capped Rockies, the great stands of timber, and the matchless inland waterways of the Pacific province form a *tout ensemble* hard, indeed, to excel. Canada thus lures the traveler with the charms of many lands in one; and, in proportion to its present population, has larger areas set aside for public recreation than any other nation in the world.

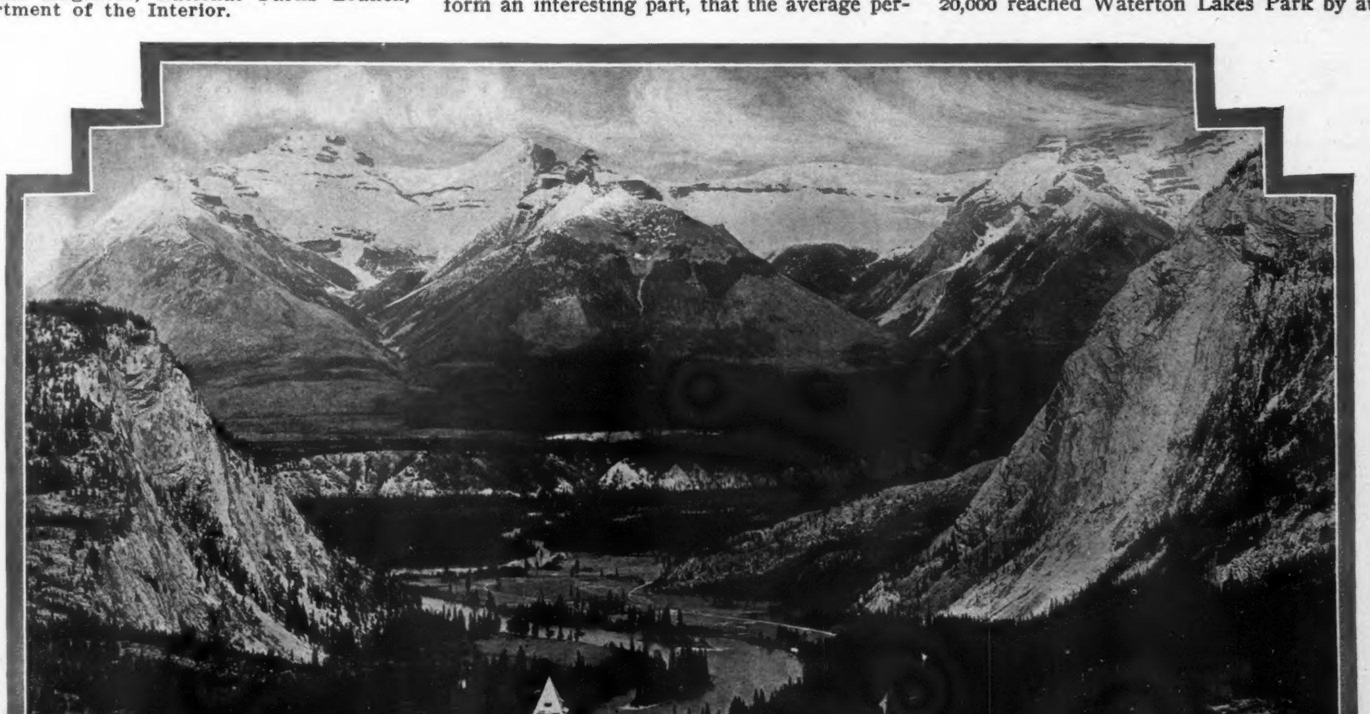
The Dominion boasts some seventeen parks or reserves—not including historic sites—varying in size from the great Jasper Park, with an area of 4,400 square miles, to some of the eastern reserves that are only a few acres in extent. Just how large a portion of the country is given over to these playgrounds can be gathered from the fact that nine of the most important parks, namely, Rocky Mountains Park, Jasper Park, Kootenay Park, Yoho Park, Glacier Park, Revelstoke Park, Buffalo Park, Elk Island Park, and Waterton Lakes Park, have a combined area of over 10,000 square miles, or are equivalent to two-thirds of the entire area of Switzerland. All these reserves are controlled by the Canadian National Parks Branch of the Department of the Interior, which not only undertakes their administration and regulation but also supervises the engineering work done within their borders.

So far flung are the Canadian Rockies and the Selkirk Range, of which the national parks form an interesting part, that the average person finds it hard to grasp their magnitude except by comparison. For instance, the Trans-Canada Limited—the fastest Canadian Pacific train—takes ten hours to pass from Cochrane, at the entrance of the Rockies, to Revelstoke, B. C., where it leaves the western limits of the mighty Selkirks and enters the coastal ranges. To cross the Swiss Alps, on the other hand, it takes an express train only five hours to go from Lucerne to Como or from Lausanne to Arona.

Although often termed the "Switzerland of America," Edward Whymper, the hero of the Matterhorn, described this district as "fifty Switzerlands in one." The Canadian Rockies and the Selkirks, comprising thousands of square miles of Alpine scenery—snowy peaks, glaciers, rugged precipices, waterfalls, canyons, lakes like sapphires and amethysts set in tree-clad mountains, have been thrown together on a scale more vast than Europe has ever known.

A large number of tourists visit this wonderland each year. For example, in 1922, a total of 79,742 excursionists came to Rocky Mountains Park; 13,000 to Jasper Park, while some 20,000 reached Waterton Lakes Park by auto-

*Chief Engineer, National Parks Branch, Department of the Interior.



**Wonderfully beautiful valley of the Bow River viewed from the mountainside well above Banff Springs Hotel. The waters of the hot springs at this resort have a daily flow of 1,000,000 gallons, a year-round temperature of 90°F., and are radio-active.**

mobile alone. The importance of this traffic can hardly be overlooked. According to one Canadian authority, tourist travel in Europe before the war netted that continent about $1,000,000,000 annually. France's share amounted to between $500,000,000 and $600,000,000; Switzerland and Italy each received from $100,000,000 to $150,000,000 of that sum; while the historic Rhine attracted travelers that were worth at least $100,000,000 to Germany. Canada's revenue from the same source last year is estimated at around $136,000,000. One strong point in the Dominion's favor is the fact that she is contiguous to the wealthiest nation in the world. The United States has the reputation of spending more than $500,000,000 annually on foreign travel; and, since the war, doubtless a fair share of this money has gone to Canada. However, as the Dominion is called "The United States' second-best customer," this money perhaps helps eventually to build up American export trade so that the benefits derived from tourist travel in Canada are very far reaching.

Good roads play a very important part in making Canada's resorts and scenic wonders accessible to the motorist and enable him to enjoy them to the full. A great deal of capital has been invested during the past few years in the improvement of these roads and highways by the Parks Branch and other departments of the Dominion government, by the various Provincial Highways Departments, and by individual municipalities. In this class of work, portable air compressors and pneumatic labor-aiding devices have been found to yield important savings and they are therefore now widely used for the upbuilding and maintenance of roads—one provincial highway board having no less than eight complete outfits in service.

The activities of the Parks Branch of the Department of the Interior, to which we shall confine ourselves in this article, have been centered chiefly in the western parks; but they will serve to indicate how Canada is using compressed air to advantage in construction work.

The administrative offices of the Parks Branch for the Rocky Mountains Park—one of the most beautiful and best-known resorts on this continent—are located at Banff, Alta. Electric light and power are essential at Banff not only for the local needs of the town and different government establishments, but also for the convenience of the thousands of people who come there annually for rest and recreation. For some years past, current had been obtained from a steam plant operated in connection with a large coal mine nearby; but the closing down of this mine and the growing power requirements of the community necessitated the construction by the Parks Branch of a small hydro-electric station.

A suitable site was selected; and it was decided to utilize an existing storage dam for the intake of the power penstocks so as to avoid, as much as possible, spoiling the natural beauty of the scenery in the vicinity of the project. After a thorough study of the proposed development, both from a construction and a business standpoint, work was begun in February, 1923. The plant was finished and successfully put in operation in February of 1924—thus establishing a remarkably good record in view of local conditions and the fact that much of the work was carried on in winter.

**One of the beautiful vistas in Rocky Mountains Park with Mount Rundle in the distance.**

The new hydro-electric station now has an output of 970 H.P. at periods of low water; but it will ultimately have a capacity of 1,440 H.P. when a third unit is added, for which provision has been made. The power house is located on Cascade Creek some 1,800 feet below the outlet of Lake Minnewanka or Devil's Lake. This lake is used as a storage reservoir by the Calgary Power Company in connection with their plants located 35 miles away on the Bow River and outside the park area. The water from this storage basin is also utilized by the Cascade Creek station and is fed to it through a 7x8-foot rock tunnel, 575 feet long and terminating in steel-and-wood-stave piping having a length of 1,300 feet and an inside diameter of 6½ feet.

In selecting the construction equipment, portable compressors and "Jackhamers" were decided upon for two reasons: first, it was desirable to buy tools and machinery that could afterwards be used for roadbuilding or other work; and, secondly, it was deemed advisable not to spend any time in erecting a permanent compressor plant. Accordingly, two 8x8-foot portable, gasoline-engine-driven compressors were put in service in February of 1923. They were placed in a small shack to protect them from heavy snow falls; and the machines were so connected that either one or both units could be operated at will With the advent of warmer weather they were taken out of the improvised compressor house and moved about to suit construction needs.

A table of the progress made accompanies this article. It will be noted that the figures are fairly complete—giving the number of gallons of gasoline consumed per cubic yard of rock excavated and also per linear foot of 7x8-foot tunnel actually driven. There are also shown the results of test runs to determine the gasoline requirements of the two compressors; and in this connection Mr. Wilkins, the construction superintendent, points out that three DDR-13 "Jackhamers" are hardly an economical load, inasmuch as the gasoline consumption is, of course, high. In his opinion, and under the conditions encountered, two such "Jackhamers" and one of smaller size would probably be about the maximum load for one compressor. For 575 feet of tunnel proper, the gasoline consumption averaged 6½ gallons per linear foot.

In order to determine the gasoline consumption of one of the 8x8-foot portable outfits both compressors were connected to the same air line, but the cut-out valve of the machine under test was set in such a way that the compressor carried the full load, consisting most of the time of three DDR-13 "Jackhamers"—the second compressor cutting in only whenever the pressure dropped and the load became too heavy for one unit to handle it unaided. In this way the machine was forced to pump air at full speed continuously during the period of the gasoline-consumption test.

The rock encountered in driving the tunnel as well as in the other associate excavational work consisted substantially of Rocky Mountain quartzite, which is very hard material to deal with. However, the equipment gave no trouble; and the tunnel was finished on June 9—just 84 days after the job was taken in hand.

After the completion of the tunnel, the compressors were employed in connection with


Fig. 1—Four thousand feet above the sea and in the heart of the Rocky Mountains near Banff, Lake Louise is called by many the most exquisite body of water in existence. Fig. 2—Towering to a height of more than 11,000 feet, Mount Edith Cavell stands an imposing monument for all time to England's martyred nurse. Fig. 3—Looking down into Marvel Lake which is one of the beauty spots in Rocky Mountains National Park. Fig. 4—Lake Minnewanka whose escaping waters furnish power for different purposes at Banff. Fig. 5—Famous Valley of Ten Peaks in Rocky Mountains National Park. Fig. 6—In Waterton Lakes Park with Sofa Mountains in the background.

drilling operations for the surge-tank and the tailrace excavations; and, later, they supplied operative air for the erection of the structural steelwork. They also furnished the energy to function a small ventilating system in the tunnel, to work a cement gun for guniting the walls, and to run two pumps utilized for unwatering the power-house foundation. Now the portables are a part of the regular park equipment and serve, particularly, on highway-construction jobs wherever rock has to be excavated.

**Oval—Type of portable compressor which is doing extremely effective work in Canada's national parks. Right—The rock drill helping to make an excavation for the tailrace of a power plant near Banff.**

TABLE OF MONTHLY PROGRESS AND OF GASOLINE AND OIL CONSUMPTION OF COMPRESSORS

| Month. | Gasoline* Gals. | Jackhamer Hours. | Compressor Oil—Gals. | Mobiloil Gals. | Work Performed. |
|---|---|---|---|---|---|
| February ..... | 89 | 63 | 2 | 2½ | 140 cu. yds. solid rock at shaft and portals. |
| March ........ | 763 | 682 | 5 | 6½ | 72 cu. yds. solid rock excavated.<br>93 ft. 7x8-foot tunnel. |
| April .......... | 1,398 | 1,280½ | 9 | 11 | 222 ft. 7x8-foot tunnel. |
| May ........... | 1,342 | 1,291 | 9 | 10 | 203 ft. 7x8-foot tunnel. |
| June 1 to 9 .. | 422 | 428½ | 1½ | 4½ | 57 ft. 7x8-foot tunnel. |
| Totals .... | 4,014 | 3,745 | 26½ | 34½ | 212 cu. yds. solid rock excavated.<br>575 ft. 7x8-foot tunnel. |

Gallons of gasoline per "Jackhamer" per hour..........................................1.07

*Imperial gallons.

The rugged construction of the modern portable compressor, with its consequent capacity to stand up under hard service; the ease with which it can be moved; its general simplicity; and the absence of bulky fuels make it an ideal power plant for this class of work.

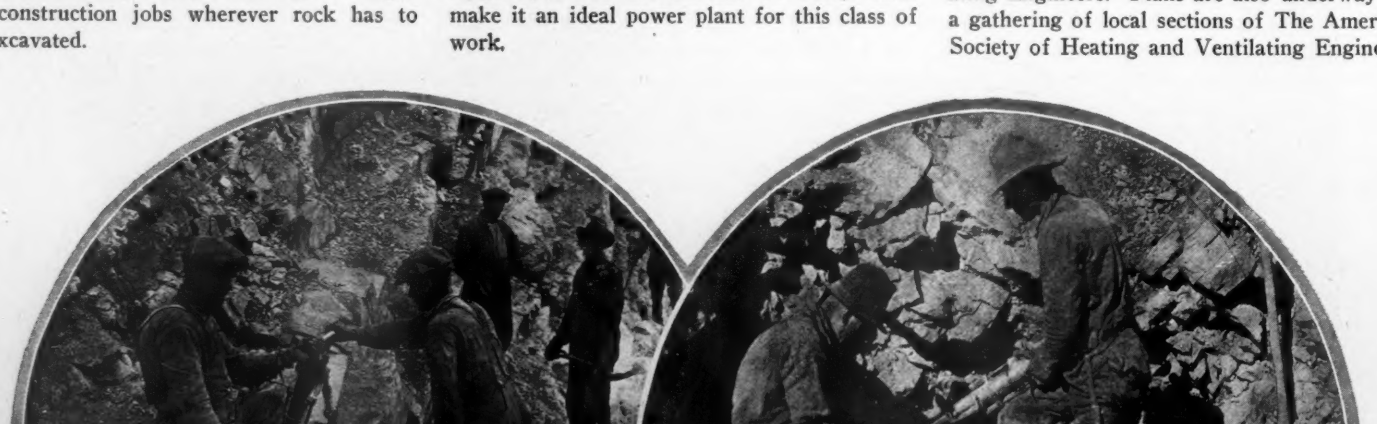
COMPRESSOR TEST RUNS

| Compressor No. | Gasoline* Consumed Gals. | Time of Run. | Consumption Per Hour Gals. |
|---|---|---|---|
| 1 | 8 | 3 hrs. 5 min. | 2.59 |
| 1 | 8 | 4 " 45 " | 1.68 |
| 2 | 8 | 4 " 30 " | 1.78 |
| 2 | 8 | 4 " 5 " | 1.96 |
| 1 | 2 | 56 " | 2.14 |
| 1 | 2 | 1 " 10 " | 1.71 |
| 2 | 2 | 59 " | 2.03 |
| 2 | 2 | 1 " 5 " | 1.85 |

Gallons of gasoline per compressor hour, 1.97

*Imperial gallons.

The Third National Exposition of Power & Mechanical Engineering is to be held in the Grand Central Palace, New York City, from December 1 to 6, inclusive. The exposition will, as usual, be coincident with the meetings of The American Society of Mechanical Engineers and The American Society of Refrigerating Engineers. Plans are also underway for a gathering of local sections of The American Society of Heating and Ventilating Engineers.



**Air-driven "Jackhamers" and portable compressors have made it possible to clear away rock in difficult places so that roadways might be built for wonder-seeking tourists.**

# Pumping Water by Air Lifts in Far-Away Hawaii

By THE STAFF

AT THE CROSSROADS of the Pacific, 2,100 miles to the south and west of San Francisco, the Hawaiian Islands rise from the depths of the sea with their mountain peaks reaching skyward, in the case of the tallest of them, to an altitude of nearly 14,000 feet. The entire group rests upon a volcanic base 15,000 feet below the surface of the ocean; and in the course of time the islands have risen from this foundation by successive volcanic eruptions which have brought them to the light of day and reared them in several instances to grandly impressive heights.

A bit of the coast of beautiful Hawaii, Cocoanut Island near the Harbor of Hilo.

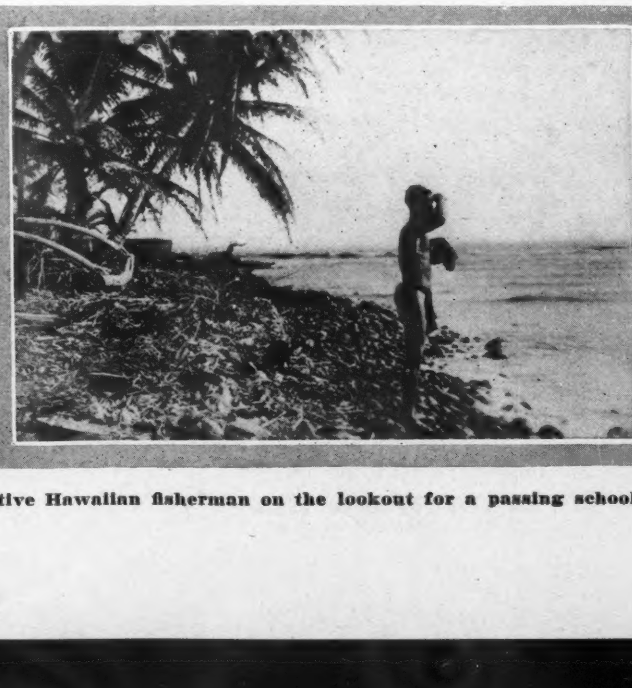
On the Island of Hawaii are two active volcanoes: Mauna Loa, 13,765 feet high, and Kilauea, 4,400 feet high. These two volcanoes lie only 16 miles apart; and with good reason Kilauea has been called the most impressive thing of its kind in existence because of its "pit of eternal fire." Whether or not all active volcanoes are terrestrial safety valves for the restless molten mass of the heart of the globe, the fact remains that once in a while craters thousands of miles apart become simultaneously restless as if they were acting in concert under a common tremendous impulse of internal unrest. Such has been the case recently with Vesuvius in Italy and Kilauea in Hawaii.

The purpose of our story is not to dwell upon seismic disturbances and the awful possibility of welling lava overflowing from craters and pouring down mountainsides in withering floods, but rather to describe how water is lifted by air from underground sources close to the slopes of Kilauea in order that a sugar plantation at Olaa can carry on its work and produce the sweetening that contributes so generously to the gratification of America's palate. For the sake of those that may not be acquainted with the figures, we are officially informed that Hawaii exported to the United States during the fiscal year of 1922-23 a matter of 1,195,078,906 pounds of sugar, valued at $69,585,641.

While the rainfall in Hawaii is abundant, the precipitous character of much of the country carries off the water very rapidly. Not only that, the soil is of comparatively recent volcanic origin and so porous that water sinks quickly out of sight to considerable depths. Accordingly, means have to be taken to raise this water to the surface from the underground reservoirs in order to meet the industrial needs of different localities. A while back, Mr. George Duncan, Chief Engineer of the Olaa Plantation, read before the Association of Hawaiian Sugar Technologists a paper of more than ordinary interest describing an air-lift installation in the Hilo district of the Island of Hawaii. His paper is too long to reproduce *in toto*, and we are, therefore, extracting from it some of its especially informative material. By way of explaining why it was found desirable to provide the plantation with two air lifts, the author tells us that, in 1904, two 12-inch wells were drilled to a depth of 240 feet, and that two 8-inch, single-acting, deep-well plunger pumps were connected to the wells. These pumps were not satisfactory.

The mill is situated 220 feet above the sea; and water was struck 203 feet below the ground level. That is to say, when drilling was concluded water stood 37 feet deep in the wells. Unfortunately, the pumps gave considerable trouble, and they did this when water was most needed. To add to the gravity of the situation, the water requirements of the sugar mill grew apace from year to year, and it was imperative that something should be done whereby the supply might be suitably and surely augmented. The growing scarcity of water was intensified when a paper mill was built upon the plantation in 1919—paper mills, as is well known, are consumers of large quantities of water.

As Mr. Duncan describes the circumstances: "We were certain there was an abundance of water at or near sea level, because from an average yearly rainfall of 200 inches there is practically no surface drainage in the territory extending from the Hilo to the Kau districts.



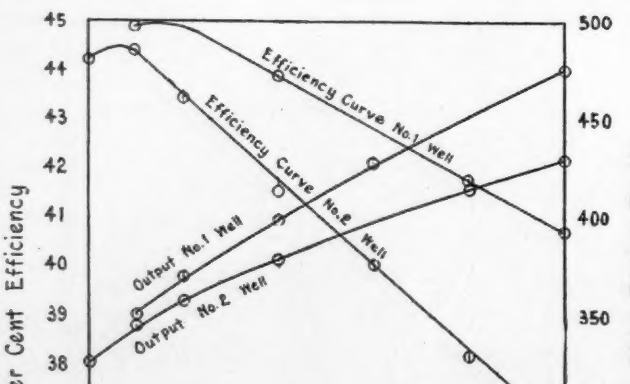
Left—Looking into Kilauea's "pit of eternal fire." Right—Native Hawaiian fisherman on the lookout for a passing school.

**Close-ups of different aspects of the teeming crater of the Volcano of Kilauea.**

All along the coast large quantities of fresh water pour into the sea the year round. From this we were justified in deciding upon the air-lift pump as the most economical means for getting the additional water desired.

"For the benefit of those who may not know the basic principles of the air-lift pump it might be well to give a brief description of this system. In its simplest form, the air lift consists of a pipe submerged in a column of water and of a smaller pipe delivering compressed air into it at the bottom. The theory is that if the water inside the pipe is to be induced to rise higher than the water on the outside of the pipe, means must be devised to lower the specific gravity of the column of water as a whole contained within the pipe. Then, the greater relative weight of water on the outside tends to force the lighter column upward.

"What could be simpler for this purpose than the introduction of air? But in order to obtain a fair degree of efficiency, means must be devised to have a thorough mixture of the air and the water. If the air is introduced in a haphazard way it has a tendency to form into large bubbles which drive through the water without doing their useful share of work. The slip of the bubbles constitutes the chief loss of energy. This varies as the square root of the volume of the bubbles. It is therefore desirable to reduce the size of the bubbles by any possible means."

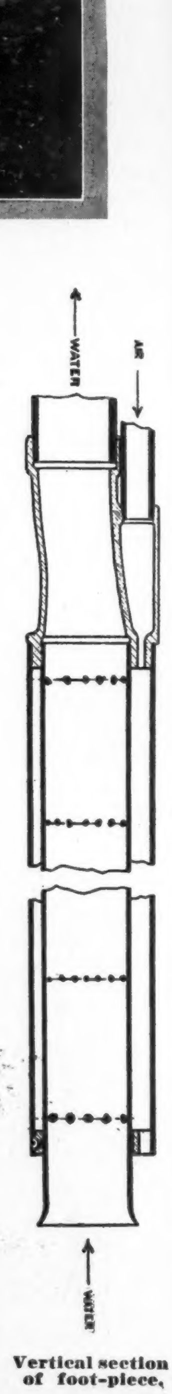



**Efficiency and output chart.**

Much time and no little money have been spent in devising apparatus which would insure this thorough mixing of air and water so as to bring about the greatest practicable reduction of the specific gravity of the water to be raised surfaceward through the discharge pipe. Outstanding success in this direction had been achieved by the manufacturers of the equipment finally decided upon as best adapted for service on the Olaa Plantation. The foot-piece of the type chosen is shown by one of our illustrations. To quote again from Mr. Duncan's paper:

"As will be seen, the foot-piece consists of an outside casing with an inside tube of brass, both attached to the Venturi connection, which helps to mix the air and the water and to give the proper acceleration at this point. The Venturi or throat is important. The foot-piece is made long enough to permit a series of rings of small holes to be drilled around the periphery of the brass tube. These rings of holes are spaced in such a way as to create sufficient back pressure in the pump so that the compressed air will enter the rising column of water with some speed, thereby again insuring a more thorough mixing with the water. This effectually helps to overcome the 'plugging' action characteristic of some systems."

Even though the efficiency of an air-lift pump may be low when compared with some pumping standards, it is probably higher than that of other apparatus used to lift water from narrow and deep wells. There are no valves or moving parts to get out of order, and, accordingly, a pump of this sort is remarkably free from those weaknesses which contribute to breakdowns. Stones and sand which might choke other types of pumps do not obstruct or




**Vertical section of foot-piece.**

halt the operation of a properly designed air lift.

In this connection, Mr. Duncan informs us: "When our installation was first started, numerous stones were thrown out of the lifts, some of them about 2 inches in diameter, while one piece was about 2½ inches in diameter and 4 inches long." Continuing his presentation of the virtues of raising water by means of compressed air, the author says: "The well can be any distance from the compressor, provided, of course, consideration be given to the size of the air pipe leading from the machine to the well. The lift requires no attention whatever, as it will start and stop as the compressor is started and stopped. This extreme simplicity and the lack of attention required offset any disadvantages which may be associated with the system. Water can be pumped through long, horizontal pipes from the air lift and, by suitable means, forced to an elevation above the ground."

Concluding his paper, Mr. Duncan gives an informative description of the two air lifts in question and the manner of their functioning. "The Olaa installation consists of two steam-driven, cross-compound air compressors, each of 14-inch stroke, together with two Class 'VA', size No. 8 foot-pieces. The two original wells—240 feet in depth—in which the single-acting plunger pumps worked were deepened to 450 feet. This was necessary to obtain the proper submergence. The dimensions of the wells are as follows:

| | | | | |
|---|---|---|---|---|
| Diameter | | | 12 | ins. |
| Depth | 450 | ft. | 0 | " |
| Static head | 203 | " | 6 | " |
| Drop | 0 | " | 0 | " |
| Pumping head | 203 | " | 6 | " |
| Submergence | 239 | " | 1½ | " |
| Percentage submergence | 54 | " | | " |

"It will be noted that there is no drop in the static head. This, I believe, is very unusual but, as was said before, when everything is taken into consideration with reference to the geology, it is not so remarkable. The two wells are within 50 feet of each other; and their output has substantiated our assumption that an abundance of water would be found. The wells are about three miles inland, and the salt content of the water amounts to 0.4 of a grain per gallon.

"The dimensions of the discharge pipes of the two pumps are as follows:

WELL NO. 1

| | | | | |
|---|---|---|---|---|
| Length of foot piece | 6 | ft. | 10 | ins. |
| First section of pipe, 4½-inch diameter | 50 | " | 0 | " |
| Second " " " 5 " " | 127 | " | 1 | " |
| Third " " " 6 " " | 124 | " | 9⅝ | " |
| Fourth " " " 7 " " | 133 | " | 10⅞ | " |
| Total | 442 | " | 7½ | " |

WELL NO. 2

| | | | | |
|---|---|---|---|---|
| Length of foot piece | 6 | ft. | 10 | ins. |
| First section of pipe, 4½-inch diameter | 119 | " | 10⅞ | " |
| Second " " " 5 " " | 139 | " | 11⅞ | " |
| Third " " " 6 " " | 175 | " | 10¾ | " |
| Total | 442 | " | 7½ | " |

"It will be seen that the discharge pipes of the two pumps are not alike. If the efficiency and output chart, reproduced herewith, is studied, the influence which the proper proportioning of the discharge pipe has on the amount of work done by the pump will be apparent at once.

"The wells were pumped at different compressor speeds—varying from 276 to 439 cubic feet of free air per minute—to determine the most economical speed and also to find out the greatest amount of water we could expect if we had occasion to need it. The results of these tests are given in an accompanying table."

WELL NO. 1

| Air Cub. ft. per min. | Water: Gals. per min. | Water: Gals. per 24 hrs. | Water: Gals. per cub. ft. air | Air Cub. ft. per gals. water |
|---|---|---|---|---|
| 293 | 350.99 | 505,425 | 1.196 | 0.835 |
| 309 | 370.04 | 532,857 | 1.193 | 0.836 |
| 342 | 400.09 | 576,129 | 1.171 | 0.855 |
| 374 | 428.30 | 616,752 | 1.143 | 0.875 |
| 407 | 452.75 | 651,967 | 1.111 | 0.899 |
| 439 | 476.01 | 685,461 | 1.082 | 0.942 |

WELL NO. 2

| Air Cub. ft. per min. | Water: Gals. per min. | Water: Gals. per 24 hrs. | Water: Gals. per cub. ft. air | Air Cub. ft. per gals. water |
|---|---|---|---|---|
| 276 | 325.86 | 469,238 | 1.176 | 0.849 |
| 293 | 346.70 | 499,248 | 1.182 | 0.846 |
| 309 | 357.65 | 515,016 | 1.151 | 0.865 |
| 342 | 378.40 | 544,896 | 1.106 | 0.904 |
| 374 | 399.00 | 574,560 | 1.064 | 0.939 |
| 407 | 415.40 | 598,176 | 1.020 | 0.980 |
| 439 | 430.40 | 619,776 | 0.978 | 1.022 |

The air pressure required is due, of course, to the submergence. Submergence ÷ 2.3 + friction = running pressure.

## PROPOSING A DAM FOR THE LOWER ST. LAWRENCE

THE diversion of the water of the Great Lakes by the Chicago Drainage Canal, causing a large flow into the Mississippi River that normally belongs to the St. Lawrence, has altered the problem of maintaining the channel for ocean-going shipping below Montreal. In consequence, it is now seriously proposed by Col. W. I. Gear, President of the Canadian Shipping Federation, to construct a dam across the St. Lawrence between Champlain and Cape Rouge—about halfway between Montreal and Quebec.

Such a dam should be high enough to give a depth of 37 or 40 feet in the ship channel; and it would also serve to develop an immense block of hydro-electric power. The structure would have to be massive enough to withstand the movement of ice in the spring. It is believed that it would cost less to build the proposed dam than to dredge the 35-foot ship channel, as planned by the Canadian government.

In open-hearth operations, one man with a charging machine has replaced 40 hand chargers.

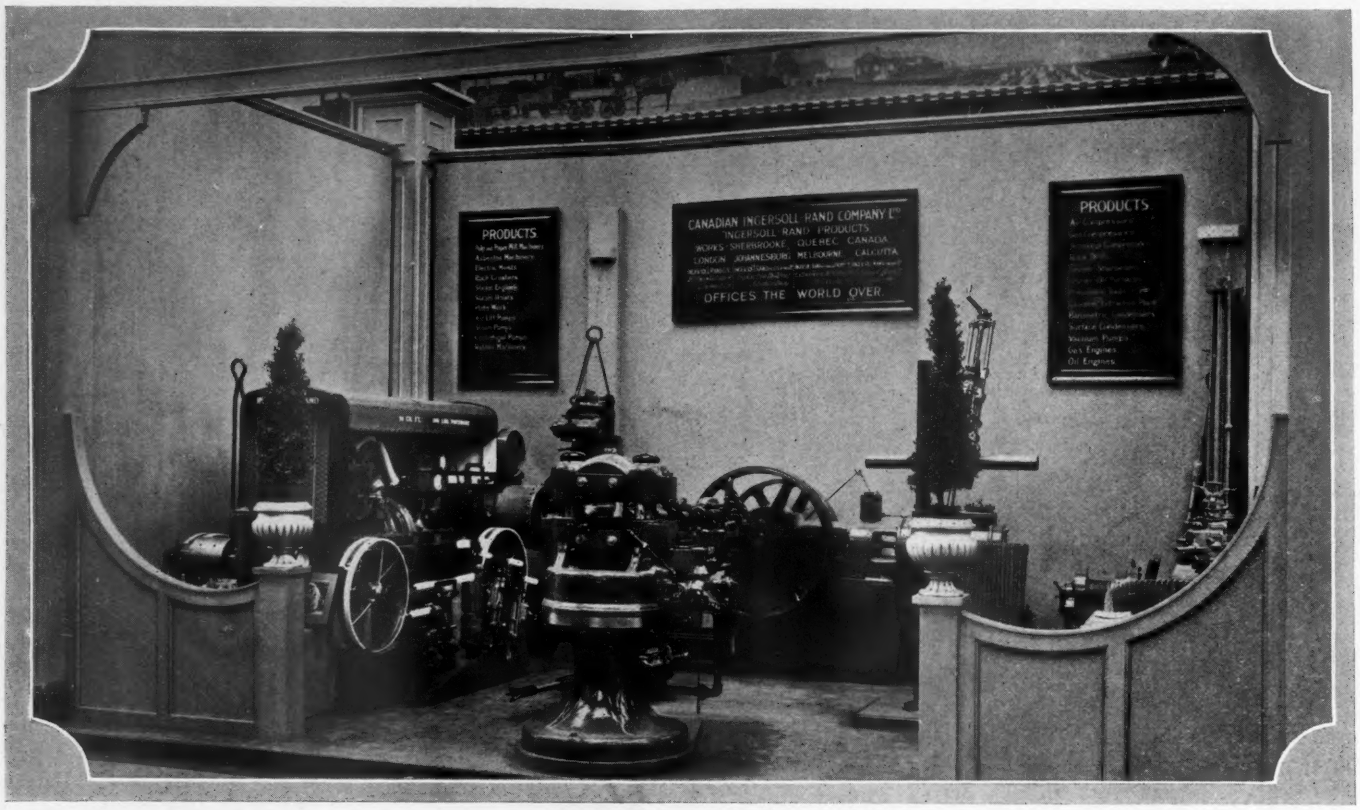
## COMPRESSED AIR AN AID TO YEAR-ROUND BUILDING

THERE has recently been conducted a nation-wide survey by the United States Department of Commerce to determine why building should not be carried on the year round. In the report following the investigations, the pronouncement is made that "the introduction of modern machinery and newer methods in construction have made building possible with very little regard to weather conditions.

"Construction with steel has gained an independence of the weather because of the hoisting engine and air-driven tools. The hoisting engine was adapted for building purposes about 1895. It not only lifts heavy parts to place without the risk attendant upon raising by hand, particularly in cold and wet weather, but also makes it possible to raise heavier pieces. It eliminates much of the labor and most of the accidents which occurred in inclement weather when laborers crawled up uncertain ladders with loaded hods, or up slippery planks with heavy wheelbarrows.

"The application of compressed air likewise has increased the practicability of all-year-round building. Compressed air in building was first utilized about 1900 to meet the demand for more economical riveting of joints in steel structures. The pneumatic hammer greatly decreased the labor and time needed for riveting—not small matters when the steel worker's complete exposure to the elements is considered."

From British engineering publications we get some suggestion of the magnitude of the radio station to be erected at Rugby. The twelve wireless masts, the big feature of the installation, are each 850 feet high—our Woolworth Building has a height of 792 feet. Each mast is pivoted on a ball-and-socket joint; it is held in position by 15 wire-rope guys; it stands on a reinforced-concrete bed, 50 by 20 feet; its top is provided with a rotating platform so as to accommodate the lead and the direction of the antennae; it is especially insulated; is fitted with powerful winches for the adjustment of the antennae; and there is provided a passenger lift that travels within the web of the mast.




**One of the Dominion's industrial bright spots in the British Empire Exhibition at Wembley. "Made in Canada" means much nowadays; and mechanical facilities manufactured within her boundaries are helping Canada to exploit and to develop her tremendous natural resources to an impressive extent. This exhibit of the Canadian Ingersoll-Rand Company, Limited, shows in part what that large engineering concern is turning out at its up-to-date shops in Sherbrooke, Que., to meet a wide variety of demands.**

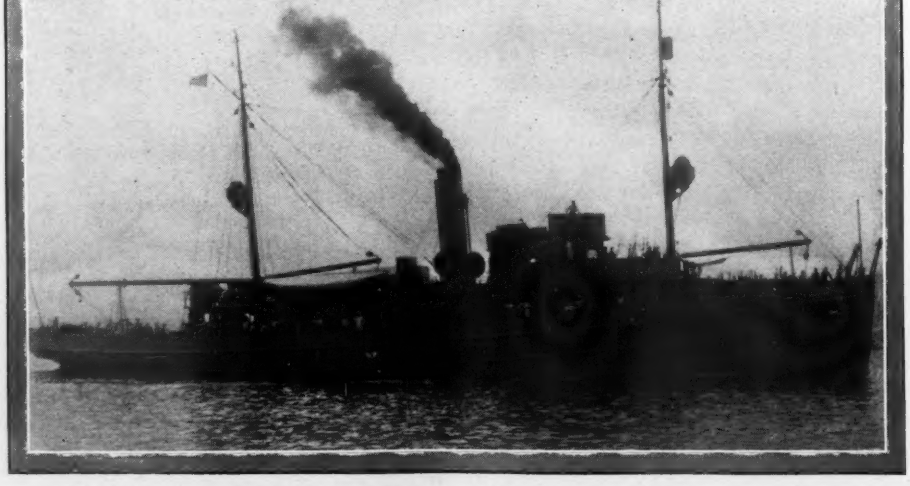
## SPECIAL UNDERWATER SALVAGE CRAFT

THAT a salvage vessel should be outfitted from salvaged material appears to be an anomaly, but that is just what happened in the case of the *U. S. S. Widgeon.* Originally built for the purpose of sweeping up mines in the North Sea, the *Widgeon* has been converted into a modern submarine salvage vessel for duty on the Pacific coast; and the various naval yards were called upon to supply left-over war materials to equip her.

The transformed mine sweeper has an overall length of about 188 feet; a breadth, molded, of 35½ feet; and a depth, molded, of 18 feet 8½ inches. In order to safeguard her hull from damage when coming in contact with other ships, her sides have been sheathed with heavy planking. To make the craft fit for her new service, she carries five air compressors. The burden of supplying the air for actual salvaging operations is placed upon two steam-driven compressors that are capable of providing sufficient air at low pressure—that is, 175 feet of free air per minute at a pressure of 100 pounds. The maximum pressure of these units is 150 pounds. In addition, there are three vertical steam-driven compressors for auxiliary service.

The recompression chamber installed aboard the *Widgeon* is six feet in diameter and twelve feet long—large enough to assure divers every comfort and convenience while undergoing recompression in case of emergency. It contains a bed, telephone, electric lights, and a phonograph, and it has sealable manholes or ports through which food can be passed if necessary. However, to safeguard divers from "bends," a series of small resting platforms are lowered from the *Widgeon,* and these make it possible for underwater workers to return gradually to the surface and to atmospheric pressure. It is said that by reason of the facilities carried, a diver will be able to work for periods of about two hours at a stretch at a depth of 150 feet. This is the maximum submergence at which sustained effort is practicable.

The *U. S. S. Falcon,* a counterpart of the *Widgeon,* was also converted from a mine sweeper into a submarine salvage vessel. The *Falcon* is assigned to duty on the Atlantic seaboard, and was fitted for service at the New York Navy Yard.



**The U. S. S. "Widgeon," formerly a mine sweeper, has been converted into a submarine salvaging craft by equipping her, among other things, with a number of air compressors and numerous pneumatic tools.**

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It is estimated in connection with the endless program of active road-building throughout the country that approximately 1,000 pounds of dynamite and blasting powder are directly or indirectly required for the construction of each mile of new roadway. The explosives are used for blasting the stone from the quarries, for cutting away rocks along the right of way, for drainage purposes, etc.; and it should not be forgotten that compressed air and the rock drill are very extensively employed preliminary to the work of blasting.

# Feldspar A Mineral Having Many Uses

## It Is the Most Abundant of All the Minerals and Constitutes Nearly Sixty Per Cent. of the Igneous Rock of the Earth's Crust

By A. S. TAYLOR

FOR THE SAKE of those unacquainted with it, feldspar may be popularly described as a younger first cousin to granite because the composition of the two kinds of rock is often similar. Each originated when much of the earth's crust was in a molten state—the granite being formed first while the feldspar followed a while later and was forced surfaceward through channels or openings caused by the shrinking and the cracking of the granite mass during its cooling.

When a feldspar intrusion stands vertical or nearly so, the formation is called a dike; and when the disposition of the material is more or less horizontal, then the geologist speaks of it as a sill. Owing to the circumstances under which the feldspar cooled within the flanking or enveloping granite structure, together with the substances contained in it, the fluid feldspar in the eons gone became an aggregation of coarse crystals, commonly known as pegmatite.

In the dim past, somewhere in the bowels of the earth, molten pegmatite was driven directly upward through part of the granite backbone of a section of the Adirondack foothills, producing a bosslike dike 400 feet wide, 1,200 feet in length from northeast to southwest, and of a depth that has not as yet been ascertained. This, the biggest feldspar dike in northern New York, outcrops on the crest of Breed Mountain a mile or more to the south of the Village of Crown Point. The feldspar is of two kinds: a pink variety containing potash and a greenish sort carrying soda. Intermixed with these is biotite or black mica.

**SOFT-BOILED eggs and air-driven drills may seem to be utterly unrelated commodities—in fact, antagonistic ones; and yet, as we shall discover presently, there is a decidedly close connection between the "Jackhamer" and the familiar eggs of the morning meal.**

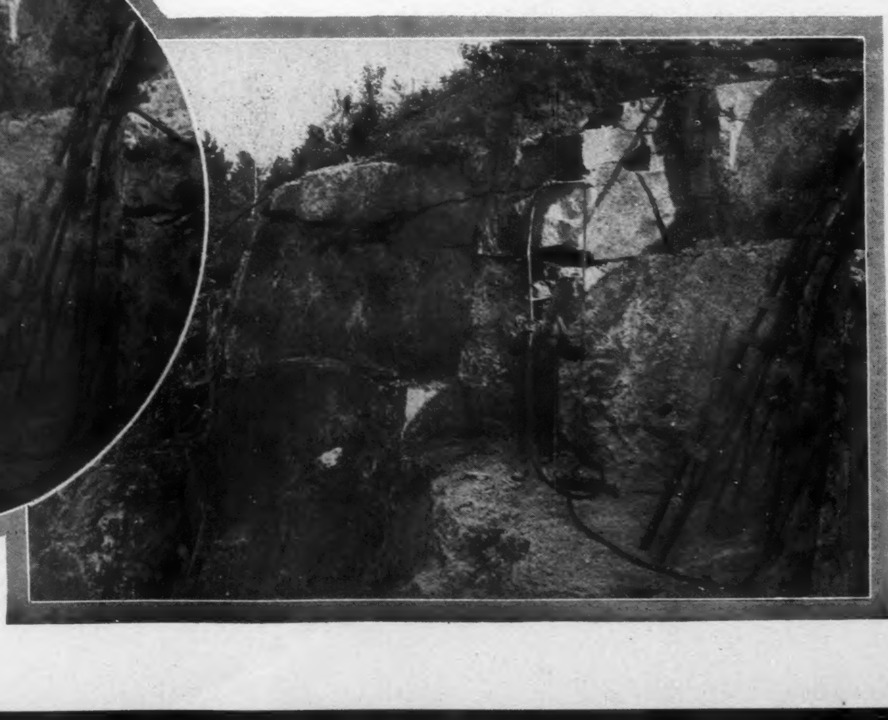
**Poultry grit is the term applied in trade to certain grades or kinds of crushed stone furnished barnyard fowl to assist digestion and generally to help the flocks wax healthy and to be prolific in the laying of eggs.**

**Much of this granulated rock is now produced from feldspar, which must be drilled and blasted free from its age-long formations; and it is the story of the mining of feldspar at a certain point in New York State that we are about to tell.**

Before describing the activities of the Crown Point Spar Company in mining this feldspar and in preparing it for various market purposes, it might be well to mention in a general way how the mineral is utilized in different departments of our industrial life. Feldspar has long been employed in the manufacture of glass, white pottery, and enameled metal wares. To a more limited extent it enters into the make-up of scouring soaps, fertilizers, etc. Enormous quantities of it have latterly been consumed in the production of rock-coated roofings and as a poultry grit, and there is a rapidly increasing demand for some grades of crushed feldspar which are utilized to give concrete structures a veneer closely resembling cut granite. Indeed, the dike on Breed Mountain is being worked primarily for the three last-mentioned uses notwithstanding the fact that much of the feldspar is of the superior sort required in the ceramic industries.

The mine was first opened seventeen years ago, but it has been energetically worked only within the last five years in response to an ever-widening market for the company's products. Depending upon the weather, operations are carried on from the first part of each April until the end of the succeeding December; and during this period anywhere from 12,000 to 20,000 tons of finished material is turned out—a loss of 10 per cent. in the form of unsaleable fines representing the average waste between the mined rock and the ground and graded feldspar shipped from the mill.

In its original form, the mill was built in 1906 close to the railroad and just back from the shore of Lake Champlain. Since then, the plant has been improved from year to year, and is commonly recognized as an excellent guide for designers of special aggregate mills. The mine or quarry is located a little more than a mile to the westward of the mill and some-



Circle—"Jackhamer" drilling holes in a bench in the face of the feldspar quarry. Right—Compressed air blowing out drill holes preparatory to loading.

thing over 500 feet above it. The problem of transporting the blasted rock has been effectually solved by the erection of an aerial tramway of the Roebling type, which has a length of 5,380 feet between terminals. The high point of this double-cable-conveyer system is 550 feet above the mill, while the loading station at the mine is substantially 100 feet below that high point. This installation has been in service seventeen years and has required no replacements in that time, except steel towers for the older wooden ones.

The arrangement is such that, while a steam engine of 40 H.P. is required to start the buckets from the mine end of the line, the system becomes a regenerative one when the buckets have passed the high point and are descending thence to the receiving bin at the end of the run. Depending upon the number of cars or buckets and their loading, they are able to deliver to the line shaft anywhere from 5 to 15 H.P.—lightening to that extent the work of the steam prime mover. Each bucket can carry 600 pounds of rock; and the conveyer has a capacity of 30 tons an hour at a speed of 250 feet a minute. Ordinarily, however, the rate of delivery does not exceed 16 to 18 tons an hour. At the eastern end of the system, the rock is dumped into a concrete bin of 200 tons capacity situated on the hillside above the mill.

To keep the sequence of operations in their proper order, it would be desirable to start with work at the quarry—for such, in fact, is the form of mining practiced—and to follow the subsequent handling of the rock until it is stored in the various bins ready for shipment. Compressed air has a number of outstanding services to perform in and around about the quarry; and to this end there is located near by a compressor house in which is mounted a 9x8-inch Ingersoll-Rand compressor of the ER class. This machine is driven by a 20-H.P. General Electric motor; and operating current is obtained from the line of the Port Henry Hydro-Electric Company. The compressor has been on the job since 1917, and has never missed a day during the working periods of the intervening years.

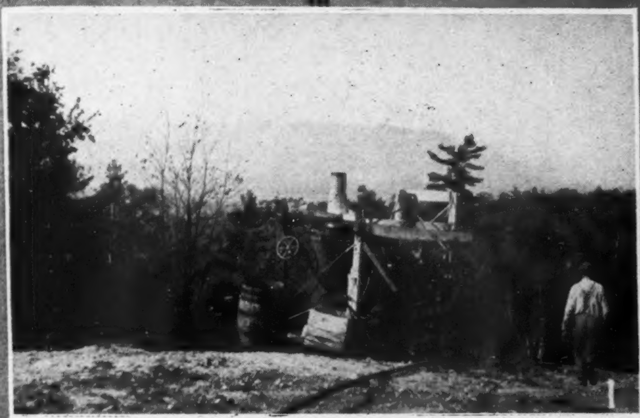
Compressed air runs a well drill when it is used as a drill and also when it is employed as a dragline in stripping the overburden from the rock. This overburden has a maximum depth of about four feet. Compressed air, besides operating the "Jackhamers" which do most of the benching and the blockholing, likewise drives riveting hammers and other pneumatic tools, runs a No. 33 "Leyner" sharpener in the blacksmith shop, provides the blast for the forge in the same shop, and blows the whistle which marks the beginning and the end of the work-day periods.

The "Jackhamers" drill holes in the bench ranging in depth from ten to twelve feet; and the superintendent speaks in the highest terms of the performances of these tools. The practice is to drill and to blast a bench and then to suspend further benching until after the rock blown down has been blockholed and mucked. This is because the face of the quarry has not heretofore been sufficiently extensive to permit continuous drilling and blasting. The intention is, however, to extend the face so that operations can be carried on in four stages without interruption to any one of these. That is to say, drilling, blasting, blockholing, and mucking will be carried on simultaneously. When this is done a crusher will be erected at the quarry. At present, all the crushing is done at the mill a mile or more away.

It is more than likely that mechanical mucking and mechanical loading of the tramway buckets will be resorted to when the volume of the output at the quarry warrants it. At present, the buckets are loaded by hand, and this necessitates considerable blockholing in order to break up the larger pieces so that they can be readily dealt with. The double-cable tramway makes it practicable to keep the buckets continuously underway from the time they leave the quarry terminal until they have dumped their contents into the crude-rock bin and have returned to the starting point. In other words, the two cables form an endless loop with the two long sides running parallel and close to one another except at the terminals. These cables are the permanent way; and the buckets are moved over it by an endless traction rope operated by the steam engine.

From the crude-rock bin the raw material is delivered to a jaw crusher, also driven by the steam plant. After leaving the crusher, the feldspar is moved by belt conveyer to a vertical drier equipped with fourteen sets of grates. Strictly speaking, these grates are gridlike baffles set in the walls of the drier tower at an angle of 45 degrees below the horizontal. They are so arranged that the descending feldspar zig-zags from one to the other as it falls, and thus the material is slowed up in its downward course—taking about fifteen seconds to make the journey. Heat is provided by a soft-coal fire; and the heat enters the drier through three different flues. The purpose of the drying is to remove from the feldspar the water or moisture caused by melting snow and ice or rain-

**Top—Aerial tramway as seen from the top of the tower at the high point of the line. Lake Champlain in the distance. Left—Air-operated well drill serving as a dragline excavator in removing overburden preparatory to extending the quarry westward. Right—Face of the quarry viewed from the floor. The intention is to greatly widen the face so as to speed up operations.**



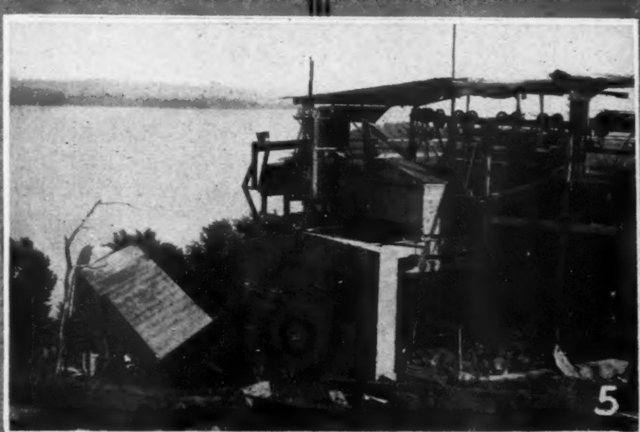
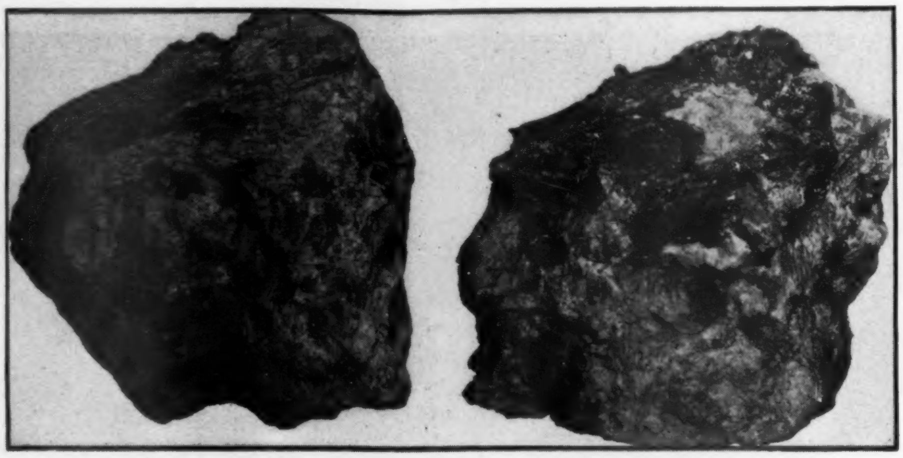


**Fig. 1—Air-driven well drill at crest of quarry.**
**Fig. 2—Compressor house and receiver located in the woods not far from the quarry.**
**Fig. 3—Quarry end of the aerial-tramway system, showing blacksmith shop in the middle distance.**
**Fig. 4—Mill at foot of the hill just inshore from Lake Champlain.**
**Fig. 5—Dumping end of aerial tramway supported by the walls of the concrete, raw-rock bin.**
**Fig. 6—Looking down upon the group of big reinforced-concrete bins in which the graded feldspar is stored to await shipment.**



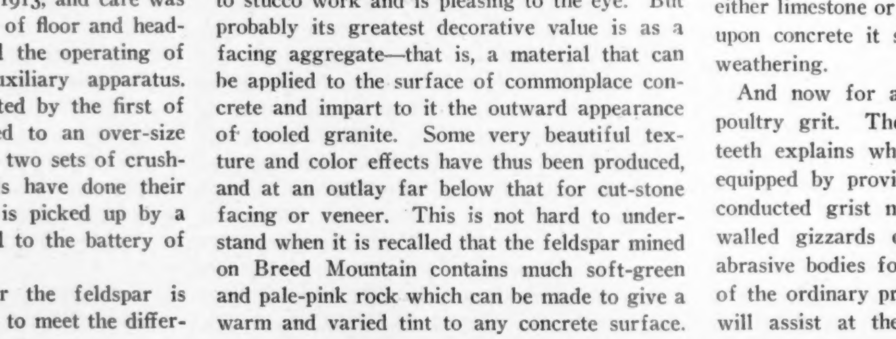
**Left—Sample of pink-and-green feldspar containing potash and soda. Right—Feldspar intermixed with biotite or black mica.**

fall. Failure to get rid of this moisture may induce packing of the fine particles and occasion trouble during the pulverizing process. Drying also gets rid of any fine dirt which may cling to the lumps of the mineral.

The crushed and dried feldspar is transported from the drier to a day-storage bin by means of a belt conveyer, and from the latter it is delivered mechanically to a disk crusher where it is further granulated. The discharge of the disk crusher is picked up by a pocket elevator which takes the spar to the top floor of the screening department which is equipped with a battery of mechanically vibrated separators having feed spreaders, bucket elevators, and a multiplicity of chutes leading in various directions. The screening department was entirely rebuilt in 1913, and care was then taken to provide plenty of floor and headroom for the installing and the operating of the separators and the auxiliary apparatus. All over-size material arrested by the first of the separators is transported to an over-size tank, from which it is fed to two sets of crushing rolls. When these rolls have done their work, the crushed feldspar is picked up by a bucket elevator and returned to the battery of separators for retreatment.

In the foregoing manner the feldspar is milled and graded accurately to meet the differing requirements of various markets; and the extent of this grading is regulated entirely by the substitution of suitable screens. The sized feldspar is delivered by a belt conveyer from the separators to day bins, each of which has a capacity of 40 tons. It might be interesting to mention here that the mineral is treated by from two to nine vibratory screens to arrive at the desired size of granules. From the mill a long belt conveyer transports the graded spar to an intercepting short conveyer belt which picks up the sized material and drops it into its proper storage bin. There are ten of these big, dust-proof storage bins, each of which is capable of holding 500 tons. Besides these there are five smaller bins, each of which has a capacity of 150 tons. It is from the storage bins that the feldspar is taken for shipment. All told, something like three miles of conveying apparatus is utilized before the finished product is deposited in the storage bins.

Because of its white and glistening appearance, pulverized feldspar lends itself admirably to stucco work and is pleasing to the eye. But probably its greatest decorative value is as a facing aggregate—that is, a material that can be applied to the surface of commonplace concrete and impart to it the outward appearance of tooled granite. Some very beautiful texture and color effects have thus been produced, and at an outlay far below that for cut-stone facing or veneer. This is not hard to understand when it is recalled that the feldspar mined on Breed Mountain contains much soft-green and pale-pink rock which can be made to give a warm and varied tint to any concrete surface.



**Two different grades of micaspar crystals used to surface concrete. They effectually imitate natural granite.**

Similarly, molded concrete forms, such as urns, lamp-posts, columns, etc., can be so surfaced as to impart to them all the richness and charm of the product of the stone mason. Concrete so coated, after allowing a suitable period for hardening may be bush-hammered the same as cut stone.

Micaspar, as the material is known to the trade, has opened up wide vistas of usefulness, and these colorful crystals can be utilized architecturally to advantage in adding greatly to the charm and impressiveness of a concrete structure. By careful attention to the grading of the aggregate, the texture of different kinds of granite can be so closely imitated as to defy detection save by experts. Micaspar absorbs far less water than either limestone or marble; and as a veneer laid upon concrete it safeguards the latter against weathering.

And now for a few words about feldspar poultry grit. The proverbial rarity of hen's teeth explains why all grain-eating birds are equipped by provident Nature with personally conducted grist mills in the form of tough-walled gizzards carrying pebbles or kindred abrasive bodies for grinding foodstuffs in lieu of the ordinary process of mastication. If you will assist at the *post mortem* of the next chicken eaten in the household you can verify this fact. From time to time, birds swallow fresh grit as the old pebbles, etc., wear away and cease to be effective in assisting digestion.

Well-nigh all the partridges shot in the neighborhood of Breed Mountain have been found to carry granules of feldspar in their gizzards, and it is even asserted that they gather there for the purpose of picking up these grain-grinding bits of rock. Be this as it may, there is no denying that granulated feldspar, because of its hardness and the sharpness of its angles, is peculiarly suited to play the part of a so-called poultry grit. Therefore, it should not prove surprising to learn that a very considerable part of the output of the Crown Point Spar Company is sold for this use.

# Progress on the Big Creek Hydro-Electric Project

## Giving Further Details of the Monumental Work in Connection With Development No. 3

### PART V

By D. H. REDINGER*

IT WILL be recalled that the text in the preceding installment had to do with some of the outstanding features and operations in connection with Development No. 3. However, the subject was not then exhausted, and our story is now resumed for the purpose of describing the concluding aspects of this phase of the Big Creek hydro-electric undertaking.

About 500 feet in from the outlet portal of Tunnel No. 3 is located the surge chamber, which was illustrated in the preceding installment. This chamber is similar to an hourglass in form—having an enlarged section at the top and at the bottom with a smaller connecting shaft. As shown in an accompanying vertical section, the bottom and the top parts are, respectively, 60 and 78 feet maximum diameter, while the central passage has a width of 26 feet.

The chief function of the surge chamber is to act as a cushion for the water column. Any surge which may be caused by the sudden shutting down of the machines in the power house will be relieved by allowing the water column to rise and to fall in this chamber. The main reason for the shape chosen is to permit small and unexpected demands to be easily taken care of by the water available in the enlarged sections without the need of carrying the chamber all the way to the surface and giving it uniformly a larger width than the present smallest one of 26 feet. The center line of the chamber is offset 48 feet from the center line of the tunnel. This location was selected primarily for construction purposes, as it was easier thus to proceed with excavating than it would have been if the chamber had been placed directly over the tunnel, where it would have interferred with work on the latter.

Excavating for the surge chamber was started at the surface by the sinking of a shaft about 8 feet square; but, later on, digging from the bottom was also taken in hand. To do this it was, of course, necessary to drive a drift from the tunnel to the center line of the chamber before beginning on the raise. When this shaft was completed, then all excavating was carried on at the top by blasting the rock—thus letting it fall down through the shaft and taking it out at the bottom with a standard steam shovel. The latter loaded the rock into 10-cubic-yard dump cars handled by combination trolley-and-storage-battery locomotives. The total amount of material excavated approximated 26,000 cubic yards, substantially all of which was hard granite.

**DRILLING hard rock at an astonishing rate is an outstanding feature of the work on the Big Creek project; and some of the recent results are especially noteworthy.**

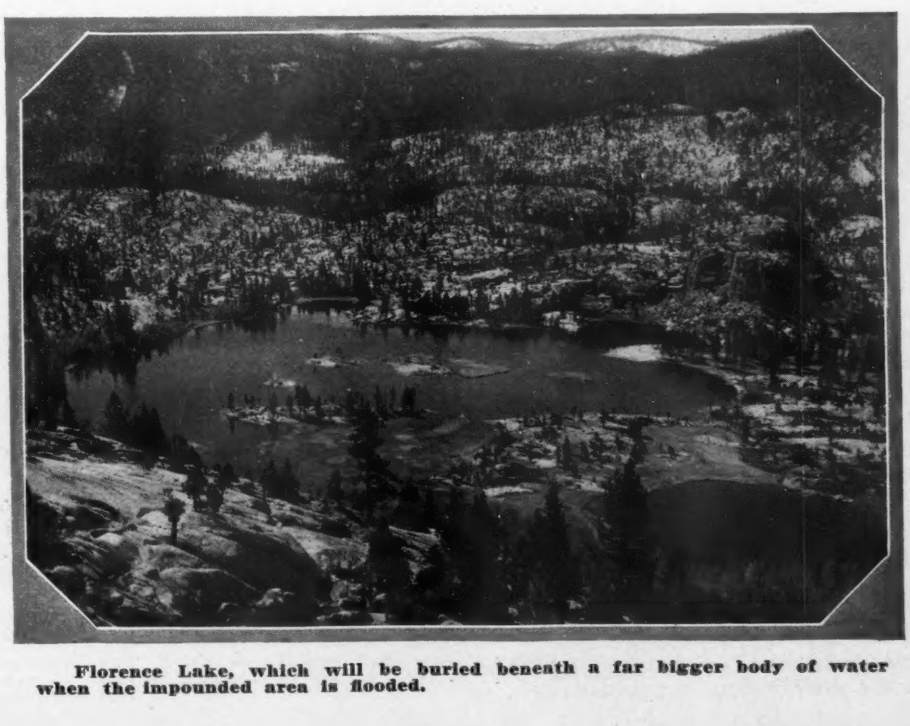
**In June, the crew at Adit No. 1, west, Camp 62, engaged on the Florence Lake Tunnel, drove 582 feet—equivalent to an average of 19.4 feet each day; but they broke this record performance during July by driving 650 feet—an average daily advance of 20.96 feet. The men of Camp 60, at the outlet end of this tunnel, drove 655 feet in July—representing a daily progress of 21.12 feet.**

**Now comes the climax as reported by the resident engineer: "Outlet crew of Florence Lake Tunnel again breaks weekly record by driving 163 feet—pulling 29 feet in a single day and exceeding their previous record by 8 feet. This means a daily average of 23.28 feet or almost one foot per hour of 15x 15-foot tunnel through solid granite."**

The only concreting done in connection with the surge chamber is a section of the spillway wall, as shown in one of the diagrams. This wall is in the form of a "cyclone" fence, six feet in height, built around the top of the chamber as a protection against animals. A cableway with a suitable hoist has been strung right across the top of this chamber, so as to enable a person to be lowered down into the tunnel above the rack bars for the purpose of inspection or for removing loose timbers that may in time be washed down through the tunnel. In work of this kind, it is not always possible to remove such material as railroad ties, for instance, some of which may have become covered with muck and are, therefore, not uncovered when flushing the tunnel prior to starting operations.

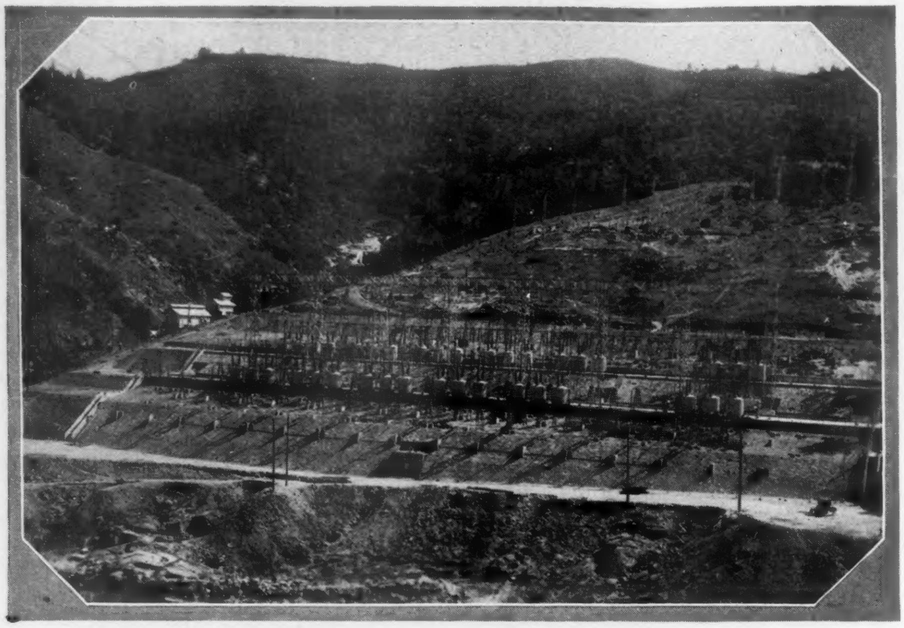
Tunnel No. 3 terminates in an 18-foot riveted pipe which runs backward from the tunnel portal for a distance of 309 feet. This pipe was installed to provide a "transition" between the tunnel section and the steel manifold, which is to be described later in this article. Interposed between the surge chamber and the inlet end of the 18-foot pipe there is a set of rack bars, which are designed to prevent any foreign material that may become dislodged in the tunnel from passing on down and into the turbines. These rack bars are made up of 3/8-inch by 4-inch bars spaced 2-3/8 inches center to center, thus giving a clear space of 2 inches; they extend across the tunnel, covering the total section; and are placed at an angle of about 45 degrees to the center line of the tunnel so as to afford a ready means of diverting any loose boards or timbers into the surge chamber.

At the outlet end of the 18-foot pipe there has been constructed a manifold of unusual design.



Florence Lake, which will be buried beneath a far bigger body of water when the impounded area is flooded.

*Resident Engineer, Southern California Edison Company, Big Creek Construction, Big Creek, Cal.

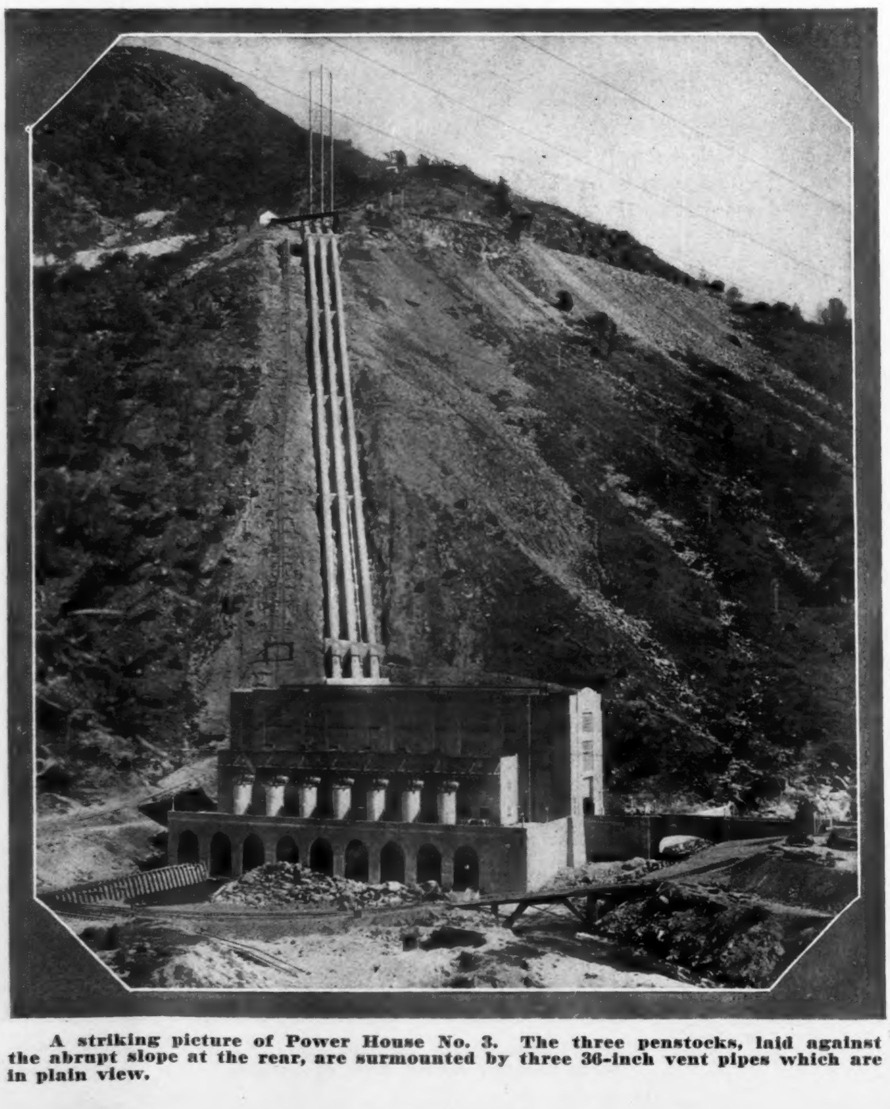


**Some idea of the volume of electrical energy generated by the Big Creek project can be gathered from this imposing outdoor switching station which controls the distribution of current from all the power plants.**

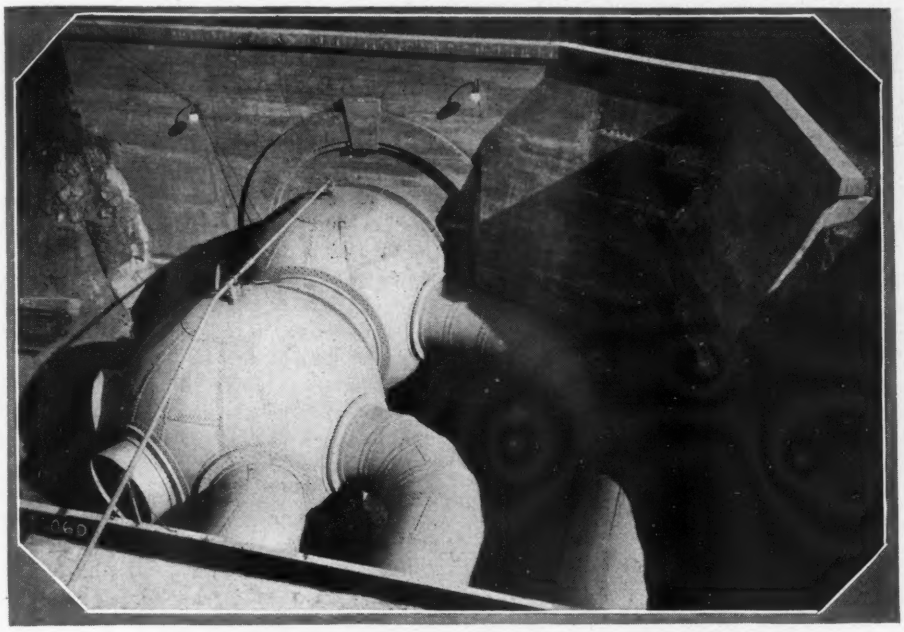
This manifold was required to form a "transition" from the 18-foot pipe to the six 7-foot by 6-inch penstocks. On account of the large diameter and the high head at this point it was not found practicable to pattern a manifold on lines similar to those of the ordinary branch fitting. Such a fitting, under the existing head of 160 feet and the diameter of 18 feet, would have involved unbalanced stresses around the outlets to the penstocks that would have been virtually impossible to take care of satisfactorily. In consequence, a radical departure was necessary; and, as a result, a manifold was adopted consisting of two 24-foot-diameter, plate-steel spheres. These two spheres are connected by a short section of 15-foot piping: one sphere having outlets for four penstocks, the other for two penstocks. The advantage of the spherical design is that the only force to be provided against is a simple hoop tension around the outlets. This force is overcome in a very simple manner by reinforcing rings placed on the outside of the pipes. The entire structure is made of riveted steel plating; and as it was wholly assembled in the shop before shipment it was erected in the shortest practicable time and with a minimum of trouble. In the bottom of the sphere that connects with the 18-foot pipe there is provided a 24-inch drain for the purpose of cleaning out any sand or sediment that might accumulate there, while a 4-inch air vent in the top of each of the two spheres terminates in a pipe that leads up to the top of the main air vents, which are attached to each penstock a short distance below the manifold.

The penstock for Unit No. 1 in Power House No. 3 leads out of the first sphere in the manifold, and on the opposite side of the same sphere provision has been made for a connection later with Penstock No. 6. The penstocks for Units Nos. 4 and 5 enter the second sphere, while the penstocks for Units Nos. 2 and 3 will subsequently draw water from the opposite side of the latter sphere. All these details are shown plainly in one of the accompanying photographs. The penstocks now completed, which are 7 feet 6 inches in diameter at the manifold, lead right from the latter to a valve house containing three 90-inch "butterfly" valves. These valves are remote controlled from the power house. When for any reason it is necessary to drain a pipe line, its respective butterfly valve is closed without in any way interfering with the flow of water in either of the two other lines. Directly connected to each penstock, and just below the valve house, there is a 36-inch air vent pipe 200 feet high. These vents tend to relieve slight surges in the pipe lines and also afford a means for letting in air in cases of emergency, should a vacuum be formed.

The penstocks are composed of lap-welded steel sections, approximately 20 feet long, and have an inside diameter for the first 250 feet of 7 feet 6 inches. Each line contains four reducers, thus decreasing the diameter first from 90 to 84 inches, next to 78 inches, then to 72 inches, and, finally, to 54 inches—the last reduction being at the entrance to the plunger valve at the power house. The thickness of the steel plating varies from ½ inch at the top of the hill to 1¼ inches at the power house. The pipe sections are riveted together in bump joints; and each line has expansion joints between the anchors, of which there are four. An expansion joint is also provided between the manifold and the valve house.

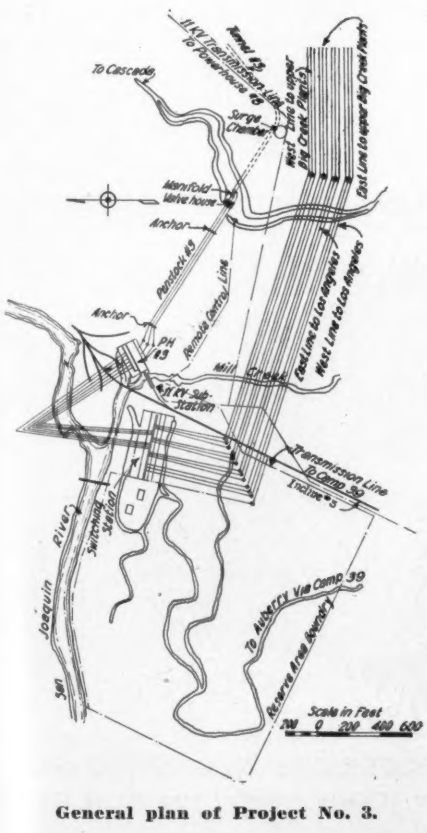


**A striking picture of Power House No. 3. The three penstocks, laid against the abrupt slope at the rear, are surmounted by three 36-inch vent pipes which are in plain view.**



A wonderful example of what the steel worker can build. The double, spherical manifold at the outlet end of Tunnel No. 3. Distribution of water from the tunnel is controlled by this structure.

Instead of resting right on concrete saddles, every second section of pipe is supported by a cast-iron rocker which, in turn, is sustained by an adequate concrete pier. These rockers were introduced primarily to lessen friction between the pipe and the piers, and have led to a large saving in the amount of concrete needed for the numerous piers. In laying the pipe lines, each unit was lowered down an incline railroad; transferred by derrick at the bottom to another car; taken up a 36-inch gage incline built alongside the penstock excavation; and then shifted onto an auxiliary track—one for each pipe line—and slid into place by means of a cable.




General plan of Project No. 3.

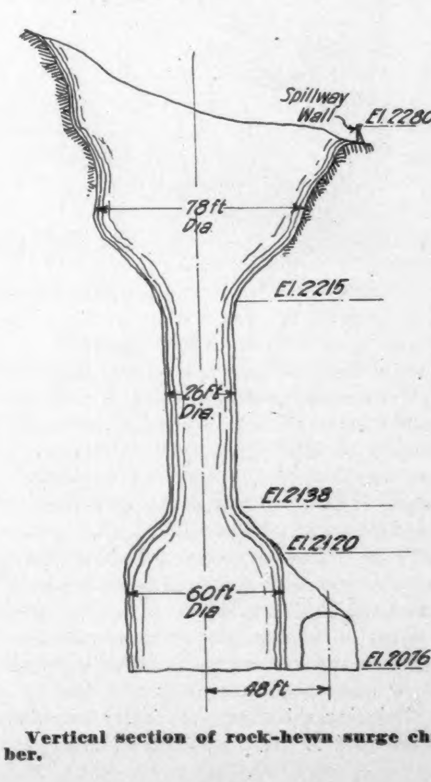
In each penstock, at a point about 250 feet above the power house, there is a Simplex water meter which automatically records the flow on a gage in the station. Control of this flow in each penstock is maintained by a 54-inch plunger valve located immediately behind the power plant. In order that the operators in Power House No. 3 may be advised at all times of the level of the water in the forebay at the intake to Tunnel No. 3, there is installed at the intake a water gage which indicates the water level on the switchboard in Power House No. 3. The work of excavating for Power House No. 3 was started on June 5, 1922, and completed January 10, 1923. Then the pouring of concrete for the foundation was taken in hand. All told, approximately 70,000 cubic yards of earth and boulders was removed and 16,000 cubic yards of concrete placed.

The present installation in Power House No. 3 consists of three 28,000-Kv-a., Westinghouse generators, each of which is connected to a 35,000-H.P., Wellman-Seaver-Morgan reaction turbine. Space is provided in the building as it now stands for a fourth unit; but when the ultimate capacity of the plant is brought up to 210,000 H.P., then a necessary addition will have to be made for the fifth and sixth units. Electric current is generated at 11,000 volts and is stepped up to 220,000 volts through transformers located on the outside of the building and above the tailrace. The first unit to go on the line was No. 2, which went into service at 7.09 p. m. on September 30, 1923; Unit No. 1 followed, on October 2, at 3.25 p. m.; and Unit No. 3 was set going at 6.02 a. m. on the morning of October 5. The plant was turned over to the operating department on October 29, 1923.

There are seven 220,000-Kv. transformers, any three of which will handle the current from two machines or generators. This arrangement makes it possible to hold one transformer as a spare—one machine running on one bank of three transformers. It will therefore not be needful to add any transformers for the fourth unit when the time comes for it to be installed. The current passes through the transformers and thence onto two feeder lines, which lead to the outdoor switching station located a few hundred feet away from the power house. The switching station is of double-bus design, and consists of 36 Westinghouse tanks—three for each 220-Kv. switch.

The main Big Creek transmission lines are looped into this station and may be energized from either bus, thereby providing 100 per cent. flexibility. Switching for all the Big Creek plants is done at this station; and the oil switches are operated from the power house by a solenoid remote control. The tanks are equipped with a supply-and-return oil system, which is fed from storage tanks by a central pumping and filtering plant. The main buses are all made of 4-inch standard iron pipe covered with three coats of red lead that serves not only as a protection against corrosion but likewise signifies danger. The disconnect switches are all locked and fitted with keys in such a manner that an operator could not err in carrying out instructions and open or close the wrong switch. In addition to these safeguards there is beneath each line a manually operated mechanical grounding device. This is also fastened in such a way that the attendant cannot work the wrong grounding device. All alleyways are properly fenced off; and the station is entirely enclosed by a cyclone fence the gates of which are locked, the respective keys being kept in the operating room of the power house. When this plant was first energized on August 28, 1923, no trouble whatever was experienced with any of the machinery, connections, etc.

All the material and equipment for Power




Vertical section of rock-hewn surge chamber.

House No. 3 and its switching station, amounting to approximately 25,000 tons, and substantially all that required for the penstocks was hauled over the San Joaquin & Eastern Railroad to Hairpin—situated above the power houses. From this point it was lowered down a standard-gage incline railway over which specially equipped cars, called "strong backs," are run. This incline has a maximum grade of 45 per cent.; is 6,800 feet long; and uses a steel cable, 1½ inches in diameter, controlled by a large electric hoist at Hairpin. The cable, itself, was purposely given a length of 15,000 feet so as to enable it to be doubled for extra heavy loads; and, according to the manufacturer, it is the longest piece of cable of that particular size ever made by him.

Now to take up again the matter of tunneling. Florence Lake Tunnel, which is now under construction and which was commenced in the summer of 1920, is the longest one so far taken in hand in connection with the Big Creek project, and will be even longer than any other tunnel now proposed for this great hydro-electric undertaking. In order to supply additional water for the plants below Huntington Lake, Florence Lake Tunnel is being pushed through the Kaiser Range so as to divert some of the flow from the south fork of the San Joaquin River into Huntington Lake.

To be concluded.

*Editor's Note: The four preceding installments of this article were printed, respectively, in our issues of December, 1923, and of January, March, and April of the current year.*

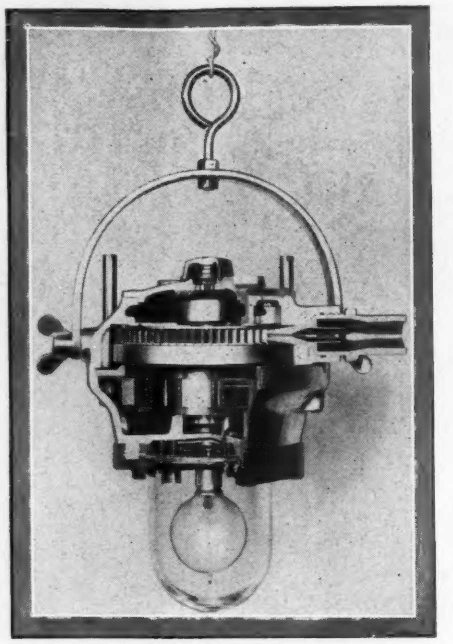
## PNEUMATIC-ELECTRIC LAMP

*By ROLAND H. BRIGGS*

THROUGH the invention of a portable, pneumatic-electric lamp, another step forward has latterly been made towards more effective illumination in collieries and in other places where electric sparking or an open flame might prove disastrous. A good light at the coal face or in the roadways simplifies the work of coal digging and, likewise, increases the safety of the miner by making more clearly visible cracks and other signs indicative of a falling wall or roof. Efficient lighting also tends to reduce the much dreaded disease of miner's nystagmus; and, apart from added security, assures an increased output. In this connection it is interesting to note how compressed air, by improving conditions and by reducing hazards, has again come to the assistance of those who work underground.

Though this new lamp is especially fitted for service wherever explosive gases may be encountered, as in collieries, near gasoline tanks, etc., there are also many other places where it may be used to advantage. For example, where a stope or tunnel is being driven by means of compressed air it is much more convenient to employ a number of these lamps than to carry electric cables along as the work progresses. The lamp gives a bright light; and it draws its operative air from the same source that supplies energy to drive the rock drills or other pneumatic tools.

In designing this lamp, particular attention has been paid to the elimination of fire risks.



**Vertical section of the pneumatic-electric mine lamp, illustrating the prime features of this ingenious outfit.**

The electric generator is an alternator with a revolving field magnet. Hence, there are no rubbing contacts or brushes of any sort which might cause sparking. The whole generator casing and the glass cover which protects the electric bulb are in communication with the exhaust side of the turbine; and a pressure of from one to two pounds per square inch is maintained by a spring-loaded exhaust valve. The outside atmosphere cannot, therefore, obtain access to the interior of the lamp when the latter is operating.

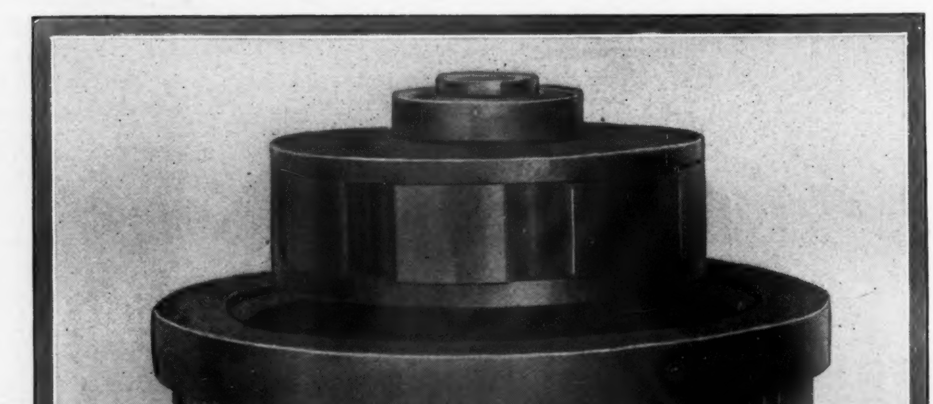
For service in coal mines, the lamp is provided with a further safeguard—a device which cuts off the current from the bulb contacts should the excess pressure within the protecting glass cover fail through any cause. Any accumulation of gas in the protecting glass, or in the body of the lamp, is prevented by a small hole communicating with the atmosphere, so that a steady stream of scavenging air passes through the whole lamp whenever it is running—thus obviating the likelihood of an explosion.

The lamp body consists of two cylindrical castings. One of these carries the generator stator, cut-out, lamp holder, and protecting glass, while the other holds the bearing that supports the turbine, the turbine jet, governor, and exhaust valve. The lamp can be taken apart and the turbine removed without disturbing the safety cut-out or interfering with any wiring or connections. The purpose of the governor is to prevent any undue acceleration in speed should the air pressure rise or the bulb burn out: it is not designed to control the lamp when running normally.

The turbine is fitted with a single nozzle that can be easily detached for inspection or replacement. This nozzle is provided with a strainer to arrest any particles of dirt which might otherwise be drawn into the nozzle and clog it. The lamp is furnished with nozzles of six different sizes for pressures ranging from 35 to 120 pounds per square inch. With a 24-watt bulb and pressures of from 80 to 100 pounds per square inch, there are consumed approximately 4 cubic feet of free air per minute, while 5 cubic feet of free air per minute are needful when the lamp is operating at a pressure of 40 pounds per square inch.

The complete lamp with swivel mounting weighs 14 to 15 pounds, not including the air line or control valve. It has a normal rating of 24 to 36 watts—the equivalent of gas-filled bulbs of about 32 and 50 candle power, respectively. Standard, 12-volt, automobile headlamp bulbs are employed; and the lamp is supplied with opal glass, to give a diffused light, or with a reflector, if a concentrated beam is desired.

It is claimed by *Automotive Industries,* for one of the familiar makes of automobiles, that improvements in its air-cooling system have made it possible to greatly increase the power output of the engine and, proportionately, the speed of the machine.



**Turbine and generator rotor. The simplicity of these essential features of the new lamp are self-evident.**

# Development of the Air Compressor for Track Work and the Uses to Which It Can be Put

By W. F. NICHOLS*

ALTHOUGH air compressors have been in service for a great many years for furnishing power for the operation of drills, riveting hammers, reamers, and for doing other work in shops and in connection with large building and bridge contracts, it was not until approximately 1915 or 1916 that the idea of using compressed air for tamping ties, drilling rails, and for performing other outside track work was put on anything like a satisfactory basis.

Prior to that time, air compressors were large and cumbersome and, unless electric power were available, the work to be done had to be of considerable magnitude and within reasonable distance to make the installation of a steam plant economical or advisable. In 1916, the gasoline-driven air compressor of small size was developed to a point where it could be used with some degree of satisfaction and dependability; and fairly large numbers of these units were purchased and placed in service on various railroads, particularly throughout the East.

My own personal contact with the first of these machines was with the 4-tool compressor put out by the Ingersoll-Rand Company. This company also made, at the same time, a 2-tool machine; but our management did not consider it economical to use less than four "guns" on a unit so that both ends of a tie might be tamped at once with the same machine and, consequently, receive much the same treatment.

These 4-tool compressors were improved slightly from time to time until the spring of 1922, when the Ingersoll-Rand Company brought out a much larger outfit, which they called a 12-tool machine. Our experience, however, showed that it was hardly capable of running twelve guns satisfactorily. This portable was further developed and improved; and, early in 1923, a much more satisfactory machine was put out with which we are now having no difficulty in operating twelve tamping guns.

In the beginning we found that it was rather hard work to get track laborers to take kindly to the air-driven tampers—complaints being made of the vibration tiring the men's arms; and the question was frequently raised as to the necessity of a relief man for every four guns to give each operator a chance to rest his arms a few minutes. In the case of certain gangs there was even some indication that we might have labor troubles on our hands if we attempted to force the men to use pneumatic tampers. Before the end of the first year, however, the situation was practically reversed, that is, after a gang had operated air-driven tampers for a few weeks we were faced with the possibility of a small strike if the tools were taken from them. At the present time, the men feel as though they had a grievance if they are asked to tamp tracks, to drill holes for bond wires, and to do other associate work by hand instead of with compressed air equipment. After the first objections to the tools had been overcome, we found that not only the trackmen but also the signalmen, bridge and building men, and all others in the department were trying to figure out ways and means by which compressed air could be used to speed up and to lighten their work; and some very ingenious devices were rigged up to this end in our maintenance of way operations. Today, the Maintenance of Way Department of the Lehigh Valley Railroad employs compressed air, furnished by proper-sized units—either 4-tool, 8-tool or 12-tool machines, for the following lines of work: tamping ties; drilling holes for bond wires; running up track nuts on new rail; running off track nuts from old rail removed from tracks; operating wooden drilling machines in connection with bridge and house carpenter work; operating cement guns; pumping water by air lifts in cases of emergency when regular pumping plants break down; and for spray painting.

Only last winter a carpenter gang used two

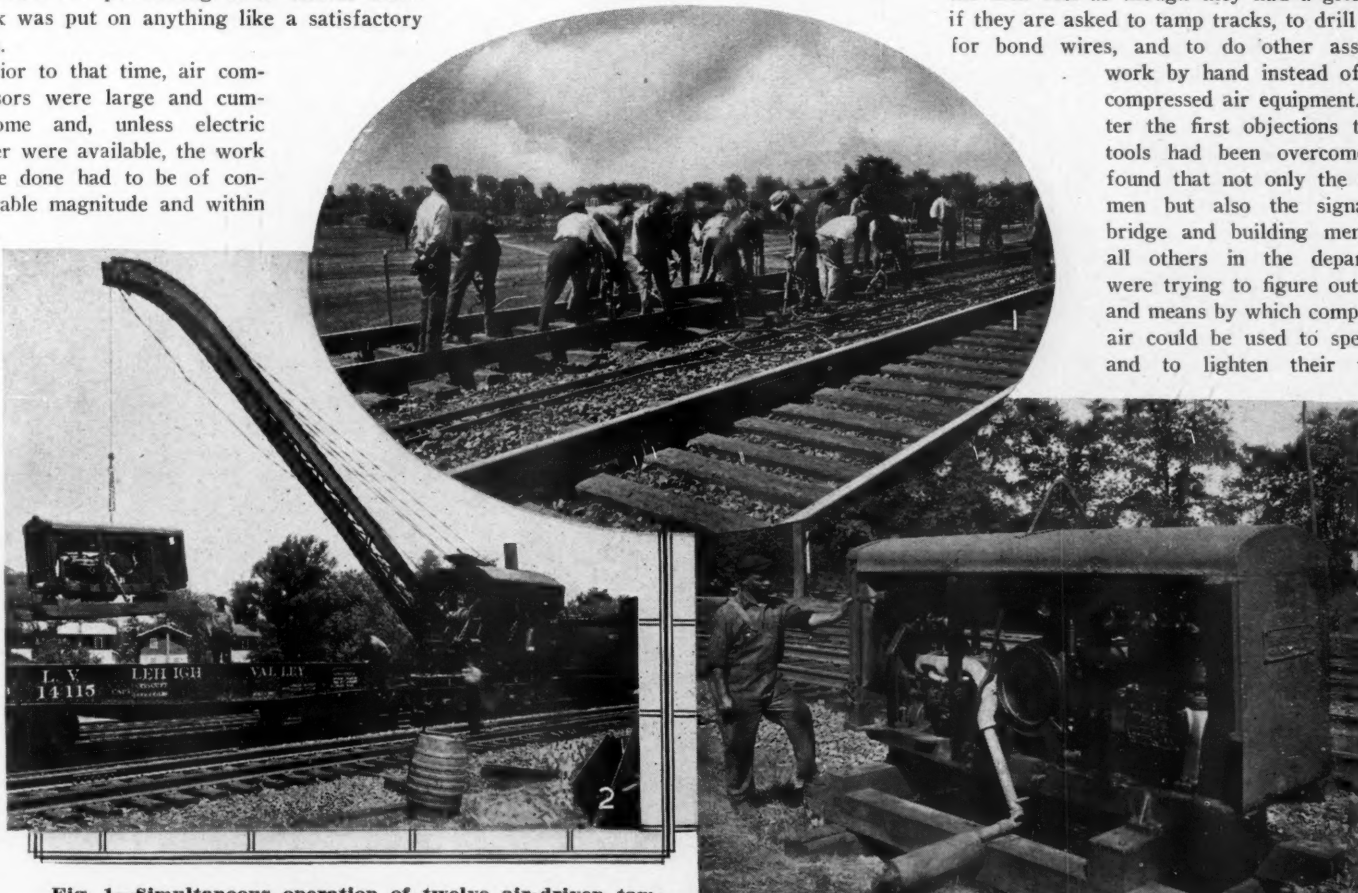



**Fig. 1—Simultaneous operation of twelve air-driven tampers tamping ballast on a section of the Lehigh Valley Railroad. Air for all these tools was furnished by a single portable compressor designed for just this sort of work. Fig. 2—Lifting a 12-tool compressor unit from a car preparatory to placing it where it will serve the purposes of the maintenance-of-way men. Fig. 3—Close-up of the portable compressor illustrating structural details of the skid mount.**

*Supervisor, Lehigh Valley Railroad, Buffalo, N. Y.

12-tool portables to furnish compressed air for operating a regular steam hoisting engine required for a pile-driving operation in a freight house where neither steam nor gasoline power was allowed by insurance regulations. The compressors were set up outside in a separate building and large air-supply lines were run to the pile driver.

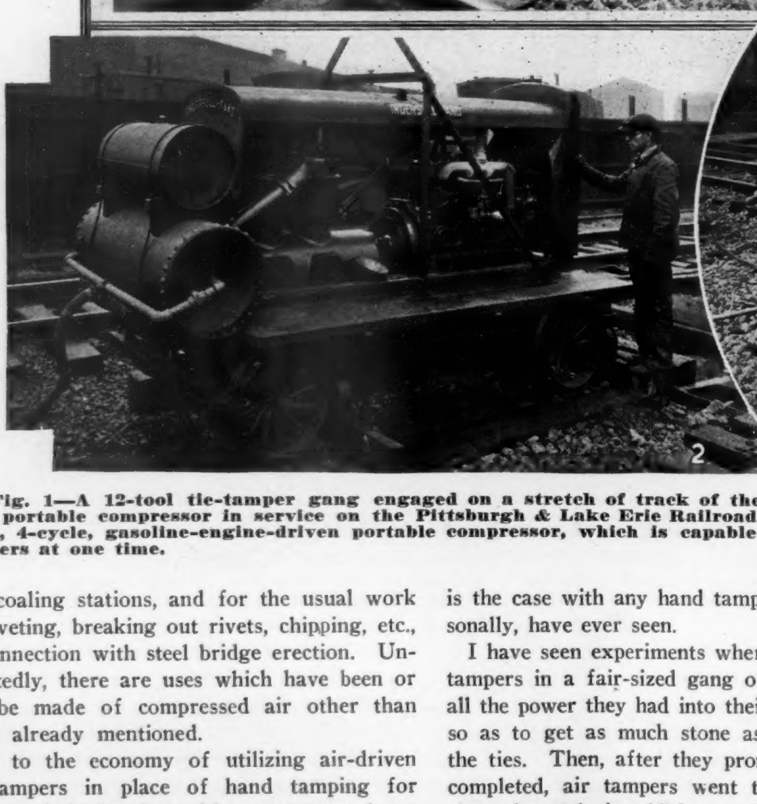
In emergencies, during the winter season, our tie-tamper compressors have been borrowed by the Mechanical and Transportation Departments for furnishing air to car repair yards and train testing lines in departure yards. We also use these machines in the winter time for cutting ice around water cranes

| | | |
|---|---|---|
| Total time for gang .......... | | 1,422 hrs. |
| Total cost of labor...... | $595.60 | |
| Total cost of material... | 108.10 | |
| Total cost ........................ | | $703.70 |
| Total cost per foot ................ | | .127 |
| Total cost of labor per foot........ | | .107 |
| Total cost of material per foot ..... | | .020 |

In addition to the fact that more track can be tamped per man or per dollar by compressed air than by hand, it is true that the work performed by air, under proper conditions, is much more evenly done; considerably more ballast is tamped under each tie; and the ballast is tamped harder. As a result, the track is put in better line and surface in the beginning and remains so for a very much longer period than

As an instance of the difference between hand tamping and air tamping, we have a location on the Lehigh Valley where new 136-pound rail was laid in the spring of 1919, where the traffic is not only heavy but very fast; and where the entire ten miles of rail was lifted and surfaced with air tampers during the following summer season. That piece of track has stood up under the heavy, fast traffic until this season, with practically no work except joining up an odd joint now and then particularly near frogs and switches, road crossings, or where the subgrade is bad. Even today that stretch is very far from a rough piece of track. This track is now being given a very light running surface, the average raise being approximately only one inch, and we fully expect that it will be another five years before it will have to be resurfaced again. Personally, I have never seen a hand-tamped job that would last that long and be as good as this one at the end of a 5-year period.

As far as the Lehigh Valley Railroad is concerned, we have definitely proved to our satisfaction that pneumatic tampers are economical and a valuable improvement over the old-style



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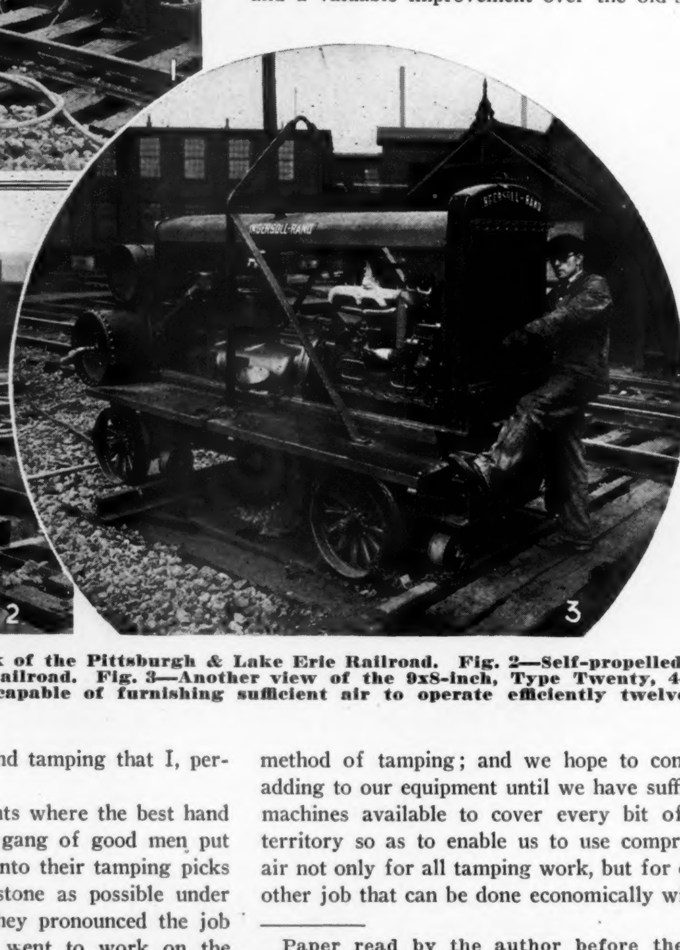

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**Fig. 1—A 12-tool tie-tamper gang engaged on a stretch of track of the Pittsburgh & Lake Erie Railroad. Fig. 2—Self-propelled, 12-tool, portable compressor in service on the Pittsburgh & Lake Erie Railroad. Fig. 3—Another view of the 9x8-inch, Type Twenty, 4-cylinder, 4-cycle, gasoline-engine-driven portable compressor, which is capable of furnishing sufficient air to operate efficiently twelve tie tampers at one time.**

and coaling stations, and for the usual work of riveting, breaking out rivets, chipping, etc., in connection with steel bridge erection. Undoubtedly, there are uses which have been or can be made of compressed air other than those already mentioned.

As to the economy of utilizing air-driven tie tampers in place of hand tamping for track work, I give, herewith, a statement showing an ordinary run for a 4-tool machine—Tamper No. 54, Ingersoll-Rand Company, located at Longwood, Section 39:

| | | |
|---|---|---|
| Track tamped, 1-inch lift ...... | | 5,525 ft. |
| Gasoline consumed ............. | | 383 gals. |
| Lubricating oil consumed ...... | | 19 " |
| Machine operated .............. | | 158 hrs. |
| Machine idle .................. | | 34 " |
| Foreman on job ...... | 158 hrs. | |
| Machine operator ..... | 158 " | |
| Crew at four tampers. | 632 " | |
| Three men raising track ............. | 474 " | |

is the case with any hand tamping that I, personally, have ever seen.

I have seen experiments where the best hand tampers in a fair-sized gang of good men put all the power they had into their tamping picks so as to get as much stone as possible under the ties. Then, after they pronounced the job completed, air tampers went to work on the same ties and—in addition to the stone already under the ties—tamped at least an equal amount and in some cases approximately twice as much. I think anyone will agree that when twice as much stone ballast can be placed under the same ties by air as by hand, without any additional raising of the ties, these ties are certainly better supported than they were before and will carry their load longer without settlement.

method of tamping; and we hope to continue adding to our equipment until we have sufficient machines available to cover every bit of our territory so as to enable us to use compressed air not only for all tamping work, but for every other job that can be done economically with it.

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Paper read by the author before the International Track Supervisors' Club, Buffalo, N. Y., June 26.

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It has been estimated that the average wheat crop is the result of 7,000,000 days of work with up-to-date farm implements. Just what modern tractors of one kind or another mean to husbandmen is strikingly brought out by the fact that the same wheat crop produced without their aid would have required 130,000,000 man-days.

## RUBBER FOR BEARINGS

A RECENT development in mechanical engineering practice, and when we come to think of it a most surprising one, is the adoption of rubber—not hard rubber—as a bearing material for spindles and shafting when running in water, where oil cannot be used as a lubricant. A substance so soft and yielding would naturally be about the last thing to be thought of for such a purpose.

Rubber has, however, one peculiarity that is not generally recognized. While it is the ideal and practically perfect elastic solid, its so-called elasticity consists almost entirely of its adaptability to change form and of its constant readiness to resume the normal shape when the distorting force is removed. It is at the same time virtually incompressible as to its volume, that is, it proves itself an unyielding substance when confined laterally and pressure is applied upon all the exposed surface.

As a bearing material, its inherent elasticity enables it to conform readily to the contour of the member in contact with it. There are no microscopic elevations or depressions, and the whole contacting surface of the rubber functions uniformly. It does not retain any stray abrasive particles, and is therefore called a "cutless" bearing. Water acts between rubber and metal as a perfect lubricant, a hint of which we have in the skidding of rubber tires upon wet paving.

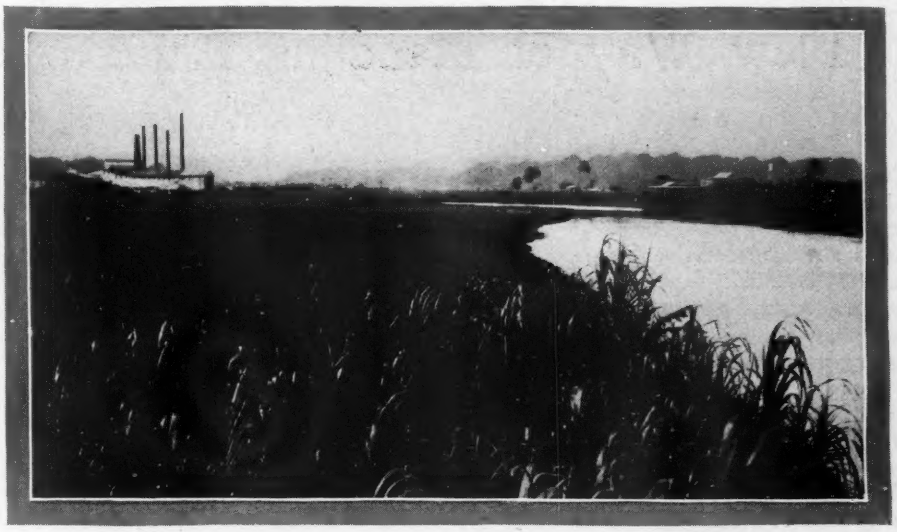
Rubber is displacing *lignum vitae* for the steps of vertical waterwheels and for the stern bearings of propeller shafts. The tank steamers operated by one of our largest oil companies have rubber bearings in their stern tubes. Bearings of this kind are also being successfully applied to the wet ends of paper machines and elsewhere, where the service is similar.

## CLEAN AND DRY AIR BEST FOR AUTO TIRES

DO YOU ever give a thought to the air that you put into your tires? Some air is good for them, some bad. Again it may be clean and dry, or dirty and damp. The former preserves the inner tube of the tire, while the latter may harm it.

Air for automobile tires is supplied by compressors. These machines must, of course, be lubricated if they are to function properly; and unless precautions are taken oil may get into the air tank. This is also true of moisture. The point is that modern air-service stations take no chances. They make it a practice to blow out—that is, to clean out their air tanks and air lines every day in the year so as to assure a supply of clean, dry air.

The first "soda water" seems to have been made by Joseph Priestley, the eminent English chemist of the eighteenth century who discovered "dephlogisticated air," that is, oxygen. Townsend Speakman, a Philadelphia druggist, flavored the now familiar liquid with fruit juices in 1807, and thus soda water was launched. It is estimated that 8,000,000,000 bottles were consumed by the American public in 1923—nearly 5 gallons for each inhabitant.



**Central Constancia produces about 8,000 tons of sugar annually.**

## SOURCE OF SOME OF OUR SUGAR

THE "sweet tooth" of America takes more to satisfy it than that of any other nation. We have it on the authority of statisticians that the per capita consumption of sugar in the United States has now reached more than 100 pounds. This may or may not explain why so many persons now stand aghast when they step upon the scales and make all kinds of resolutions looking to a reduction of their waist lines. Be this as it may, the fact remains that two years ago the production of cane sugar alone in this country totaled the amazing amount of 3,342,000 tons.

Much of the cane sugar used by us comes from the West Indies, where the waving cane grows upon expansive and numerous plantations. The accompanying pictures show various aspects of one of these plantations and of the mill, or *central,* where the cane is crushed and the sweet juice worked into raw sugar—the product handled later in our domestic refineries.

Central Constancia, the one illustrated, produces annually approximately 8,000 short tons of sugar. It is equipped with two 17x10, XB-1 vacuum pumps which play an important part in evaporating the water from the cane juice in converting it into a thick syrup that will yield molasses and raw sugar. Only one of these pumps is in service at any time—the other constituting a spare. Reciprocating pumps are used to remove condensate, and this tends to increase the effect of the vacuum pump. The Central Constancia is a fine example of a modern, electrified mill.

## SEAPLANE ON REGULAR RUN

THE Canadian Pacific Railway has put what it terms a flying boat into regular service in connecting a branch terminal with Quebec's new gold fields. The seaplane is capable of carrying five passengers, including the pilot, with some baggage; and it is scheduled to make three trips a week from Angers to Lake Fortune and Lake Rouyn—returning to its base the same night. Four zones, within a radius of 80 miles, will be covered. The machine is equipped with a 350-H.P. Liberty motor, has a lifting capacity of 1,000 pounds, and can make a maximum speed of 85 miles or a cruising speed of 70 miles an hour.

**Vacuum pumps in the Central Constancia.**

# New Way of Handling Liquids By Compressed Air

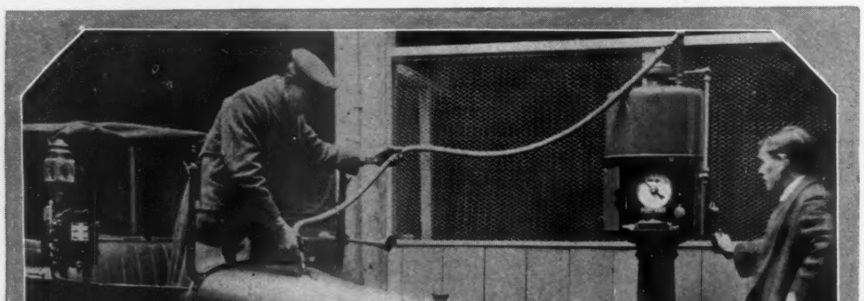
By A. C. WOODSIDE

FOR THE PAST three years there has been in service in Europe an improved system for pumping fluids by means of compressed air. This development is the invention of Pierre Mauclère, a well-known French engineer. At the present moment, Mauclère installations are principally employed for distributing motor fuels and other hydrocarbons, but the method is being gradually extended in other directions.

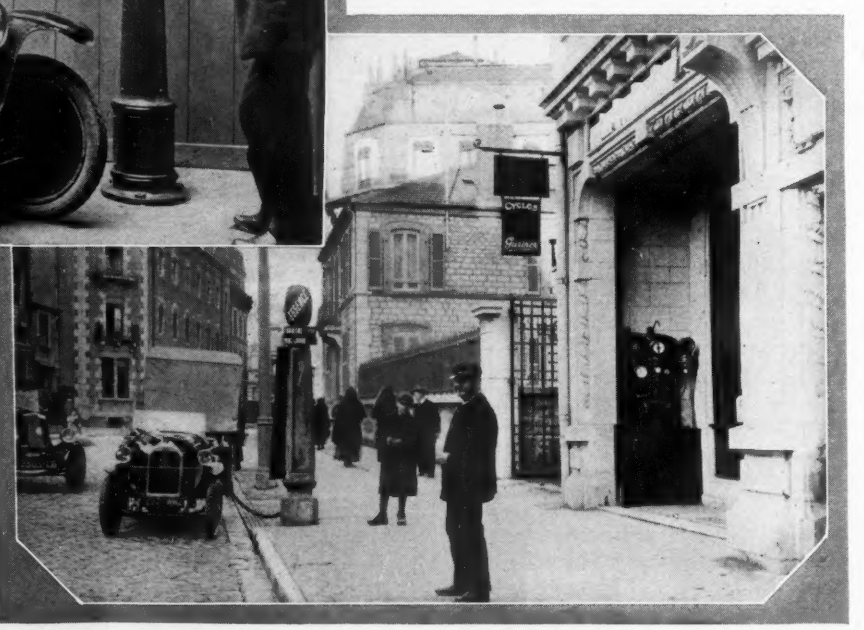
This system may be considered a logical development of the well-known method of elevating liquids by the direct application of compressed air to fluids held in closed tanks. In a mechanical sense, this method has been found very convenient. Any good compressor may be used to pump air into the tanks; and when the pressure applied to the surface of the liquid has been raised to a point equaling the maximum head, the liquid is available anywhere throughout the establishment to which it may have been piped—just like city water. With the release of the air pressure all the liquid drains back into the tanks. This system is still extensively utilized for lifting gasoline in garages and service stations, and is also employed in certain paint and varnish works for elevating oils or solvents. However, it has its disadvantages.

Putting pressure on large tanks, especially those containing inflammable liquids, is not desirable. Leaks are more difficult to prevent, and there have been recent cases of bursting, due probably to some negligence which resulted in the application of excessive pressures. Putting pressure on gasoline tanks is already forbidden in most cities; and in fire-prevention circles the practice, as concerns inflammable liquids stored anywhere, is regarded with disfavor.

The system also has minor disadvantages. Tanks which are to sustain pressure must be heavy, and the joints carefully welded. Furthermore it is the general practice—obligatory in the case of inflammable liquids—to release the compressed air each night lest a broken pipe or a coupling flood the premises. This results in vapor losses, the money value of which is just beginning to be appreciated. Again, considerable time may be wasted each morning in getting the tanks up to working pressure, especially if the liquid level be low. Finally, it is impossible to fill a tank while drawing from it. In a busy establishment it may, therefore, be necessary to have two tanks for each liquid.



Small service station equipped with Mauclere system for handling gasoline.

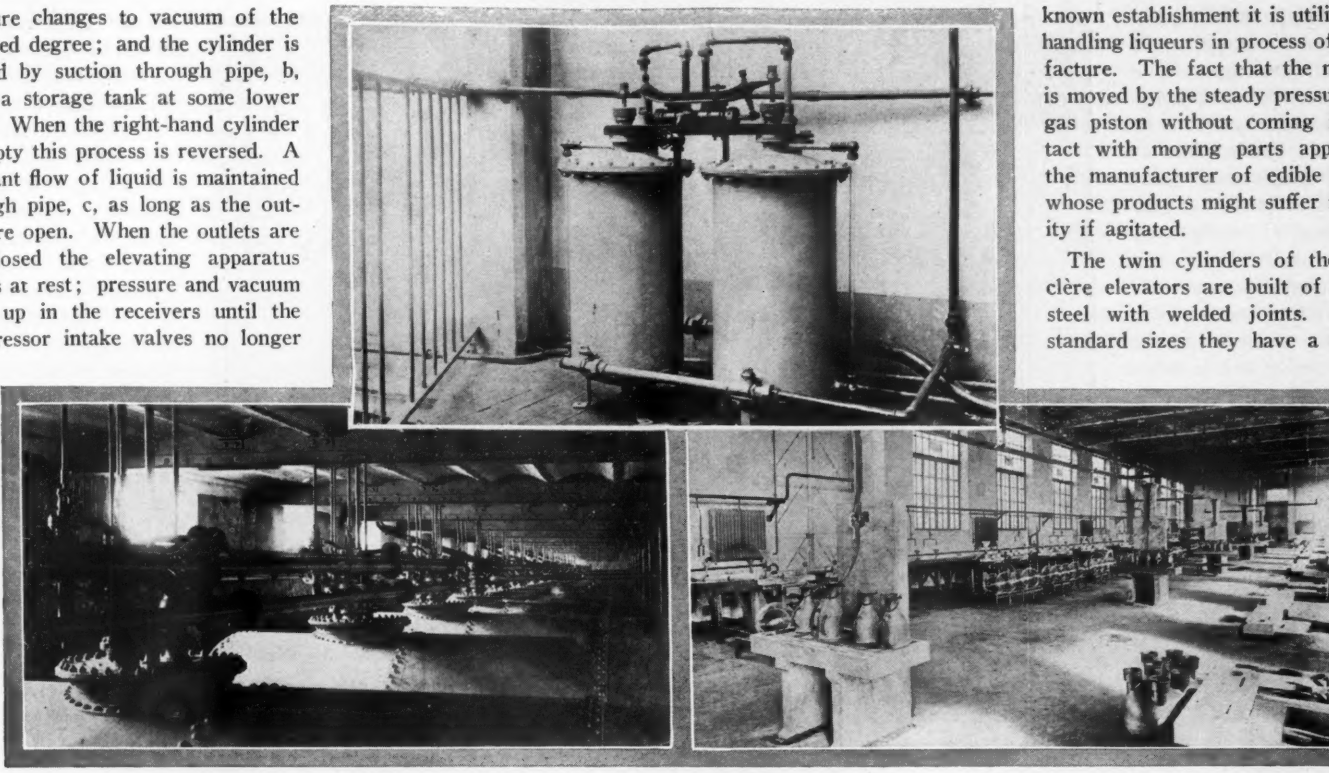


Distributing gasoline pneumatically at a garage in Besancon-les-Bains, France.

With the new system, an indefinite number of liquids may be put under constant head at any point in the plant where these fluids may be wanted. Likewise, all the aforementioned objections are avoided. The storage tanks, which may be of light construction and undergo filling at any time, are always at atmospheric pressure. Such an installation is ready to work at full capacity within one minute after the compressor has been started. As the compressed air is used in a closed circuit there can be no vapor losses. When the liquid is to be restored to its normal level, a valve between the pressure and the vacuum receivers is opened and the whole system, no matter how many pumping units are involved, instantly returns to atmospheric pressure. The lines may then be drained, if desired. Only a few gallons of liquid are under pressure at any one time. If the apparatus were damaged in any way these few gallons might escape, but that is all, and the unit would cease to work. As soon as the air valves controlling this particular unit were closed, the balance of the system would function as before. By reason of these improvements in the raising of fluids, it is not surprising that in Europe the application of the Mauclère system to inflammable liquids has worked a reduction in insurance rates.

In the accompanying diagrammatic sketch the compressor is shown taking the air from one receiver and discharging it into another smaller receiver. When the vacuum in the former corresponds to the required suction lift, the pressure in the latter is equal to the required pressure lift of the liquid being handled. The higher the pressure lift the smaller the pressure receiver necessary. In the sketch, the air pressure is applied to the surface of the liquid in the left-hand cylinder of the elevator and the liquid is flowing to the outlets through pipe c. In a few moments the float, i, will reach the button at the lower end of the guide rod; the air switch, g, will be thrown; and the pressure of the air will be transferred to the right-hand cylinder, from which the flow of liquid through pipe, c, will be continued without sensible interruption. At the same time the left-hand cylinder is opened to the vacuum receiver;

pressure changes to vacuum of the required degree; and the cylinder is refilled by suction through pipe, b, from a storage tank at some lower level. When the right-hand cylinder is empty this process is reversed. A constant flow of liquid is maintained through pipe, c, as long as the outlets are open. When the outlets are all closed the elevating apparatus stands at rest; pressure and vacuum build up in the receivers until the compressor intake valves no longer open; and the compressor then runs light as with an unloading device. No serious excess pressure can develop, because there are but few cubic feet of air in the system. Furthermore, there is a safety valve in the line which connects the two receivers.



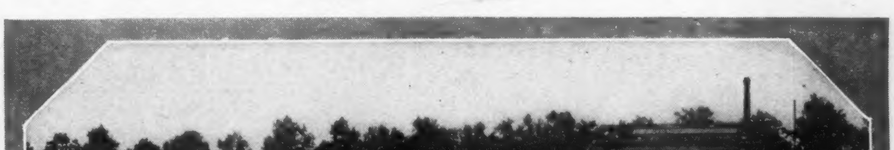
**Top—Twin-cylinder elevator having a combined capacity of about sixteen gallons. Left—Gasoline storage tanks, at a distributing depot in Paris, operated by the Mauclere system. Right—Smokeless powder plant in Europe in which the solvent used is conveyed pneumatically.**

Any number of elevating units, each handling a different liquid, may be operated from a central compressor station. At the French military aviation field, at Le Bourget, an apparatus of the type in question is used to deliver three different grades of gasoline through the metered outlets. It has a total capacity of 2,000 to 2,500 gallons per hour; the compressor is rated at 23 cubic feet of free air per minute; and slightly over 2 H.P. are needed to drive it. The vacuum receiver has a capacity of about 8.5 cubic feet, and the pressure receiver about 5.5 cubic feet. The maximum pressure amounts to about 16 pounds, and the maximum vacuum is approximately 19 inches. The total gasoline-storage capacity of the installation is about 37,000 gallons; and no pumping appliances other than those shown are necessary.

At the military transport depot, at Metz, the French government has substituted the Mauclère system for one previously placed there by the Germans, and is employing it to supply gasoline to motor trucks. As a matter of fact, the French are now operating three such plants and have two more under construction. The Spanish government, likewise, has three similar installations in service; at Brussels, Belgium, the fire department and the motor omnibus company have adopted the system; and the street-cleaning department of Utrecht, Holland, has also found its application of advantage. Among private European industries that have put it to practical use are: steel plants, oil fields, tire factories, coal mines, numerous workshops, garages, chemical plants, and the like. Some recent installations have been made for the purpose of conveying vegetable oils, margarine, and carbon bisulphide. In one well-known establishment it is utilized for handling liqueurs in process of manufacture. The fact that the material is moved by the steady pressure of a gas piston without coming in contact with moving parts appeals to the manufacturer of edible liquids, whose products might suffer in quality if agitated.

The twin cylinders of the Mauclère elevators are built of ⅛-inch steel with welded joints. In the standard sizes they have a net capacity of 8, 13, or 27 gallons. For special purposes they have been built small enough to hold only 3 gallons; and there is no limit to their increase in size. But inasmuch as it is possible to get from 150 to 175 alternations of the air switch per hour, it will rarely be necessary to use cylinders larger than 13 gallons for the kind of work to which the Mauclère system is particularly adapted. Generally speaking, these pumping problems have in them an element of delicacy—they are problems involving the intermittent handling at moderate lifts of a variety of liquids. High lifts may, of course, be effected, but at reduced efficiency in respect to power.

The size of the compressor is determined by the volume of liquid to be delivered per minute and by the head; and the vacuum receiver is ordinarily twice or a little more than twice the size of one elevating cylinder. When a number of elevating units are operated from one pair of receivers the size of the latter must be increased, though not in the same proportion.



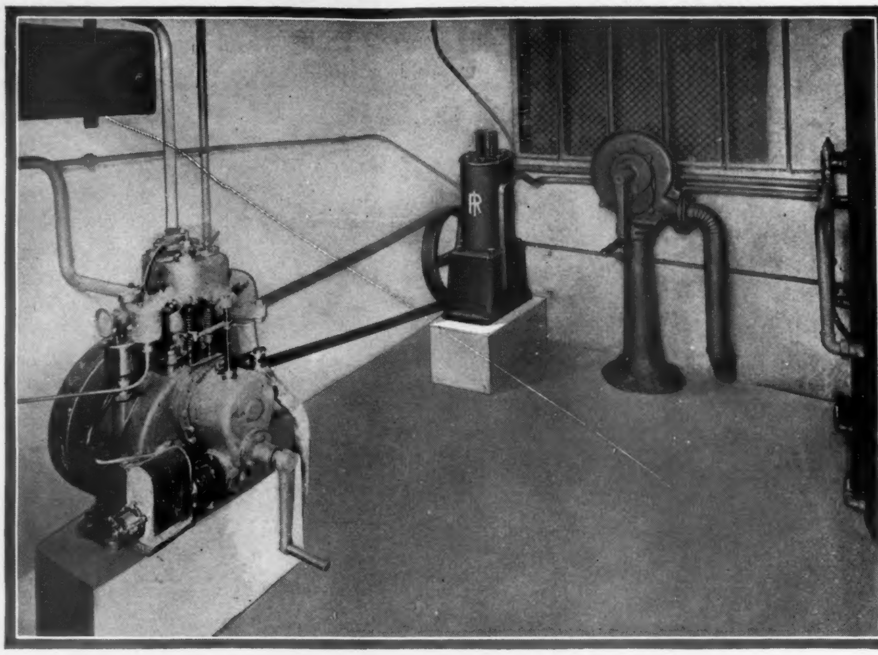
**Station of a Parisian omnibus company equipped with an earlier type of Mauclere system for raising and delivering gasoline.**

At Le Bourget, nitrogen instead of air is utilized as the operating gas, a special but probably unnecessary precaution against the occurrence of an explosive mixture in the system. As the gas is used in a closed circuit, with no loss except

small unavoidable leaks, a flask of nitrogen will last a long time. The possibility of employing an inert gas, or of using the same air indefinitely, makes the system peculiarly adaptable to the handling of easily oxidized oils.

For certain purposes, where the suction lift may be dispensed with, the pumping unit is operated by gravity compression alone, and a slight gain in mechanical efficiency is thus secured. This will be the case at a large steel plant in France, where a Mauclère apparatus of this type is being installed to handle lubricants for the circulating system. In this way, nineteen gas engines, operating blowers and generators, are to be served as well as five steam turbines, run by coal-fired boilers, which are to take care of peak loads. Four grades of lubricating oil will be so distributed.

The gravity-compression type of apparatus is also employed in the plant of an artificial silk company, at Lyons, for lifting carbon bisulphide from storage and delivering accurately measured quantities direct to the mixer. In this case, owing to the dangerous nature of the liquid, the whole pumping operation is carried on under a protecting sheet of water. The liquid, at no time, comes in contact with the air. Units of this description are also recommended for hot solutions or for such mixtures as give off vapors that might corrode the compressor valves, and they have the added advantage of being able to operate on compressed air from any source.



**Gas engine and compressor used at a military aviation field in France where the Mauclere system is employed. The installation permits the simultaneous handling of three different grades of gasoline.**

## TESTING AIRPLANE FABRICS

WE MAY well believe that perhaps the most responsible detail in airplane construction, the material used for the wings, has been the subject of unending research and experiment. A valuable paper covering this topic was presented by Mr. J. E. Ramsbottom, of the Royal Aircraft Establishment, at a meeting held in connection with the British Empire Exhibition.

The fabrics are never employed in the untreated condition, but are coated, usually by means of compressed air, with a special dope to produce a taut, airtight, and watertight surface of light weight. The strength of a doped covering is best measured by a bursting test approaching the conditions of actual flight. To allow for accidental damage or perforation by bullets, experiments are made with wounded specimens. The material is clamped onto a metal frame, the ratio of its sides corresponding to the fabric panels of a full-sized airplane. In arranging the material, the warp is made to run parallel with the longer side; and pressure is applied by means of water. As the stress is borne mostly by the weft threads, cuts across them are the most dangerous.

As regards weathering and seasonal influences, it was found that linen treated with clear acetylcellulose lost 5 per cent. in strength by exposure during the month of January and 45 per cent. in July—the chief factor in this deterioration being sunlight. The relative losses in cotton, linen and silk are as 4:6:10. In heat tests, conducted by keeping fabrics in a stove at from 80 to 100°F. for 1,200 hours, it was determined that mercerized cotton was more resistant in this respect than any of the other materials.

As light is the chief destructive agent, experiments have been made with a view to keeping light out by dyeing the fabric, by using a flexible, pigmented varnish, and by introducing both pigments and dyes into the dope. The admixture of pigments reduces slackening in moist atmospheres, saves weight—no varnish being required, and gives a more uniform layer.

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A tunnel exclusively for pedestrians, with a vertical shaft and "lift" at each end, is to be built under the River Liffey, at Dublin, at a cost exceeding $250,000.

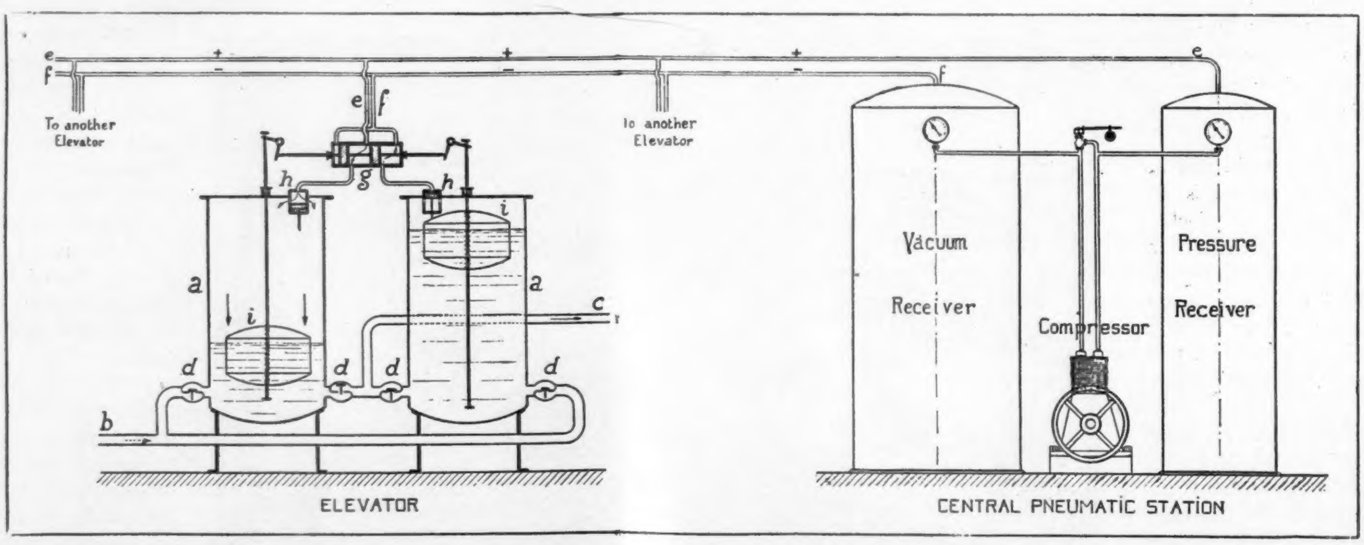



**Diagram of the essential features of the Mauclere system for dealing with liquids. Duplex, air-tight tanks, a; inlet pipe for liquid, b; discharge pipe for liquid, c; check valves on inlet and discharge pipes, d; pressure pipe for air or gas, e; vacuum pipe for air or gas, f; automatic switch for alternate control of pressure and vacuum, g; valves to protect air lines against entrance of liquid, h; and i, floats for control of automatic switch g and valves h.**

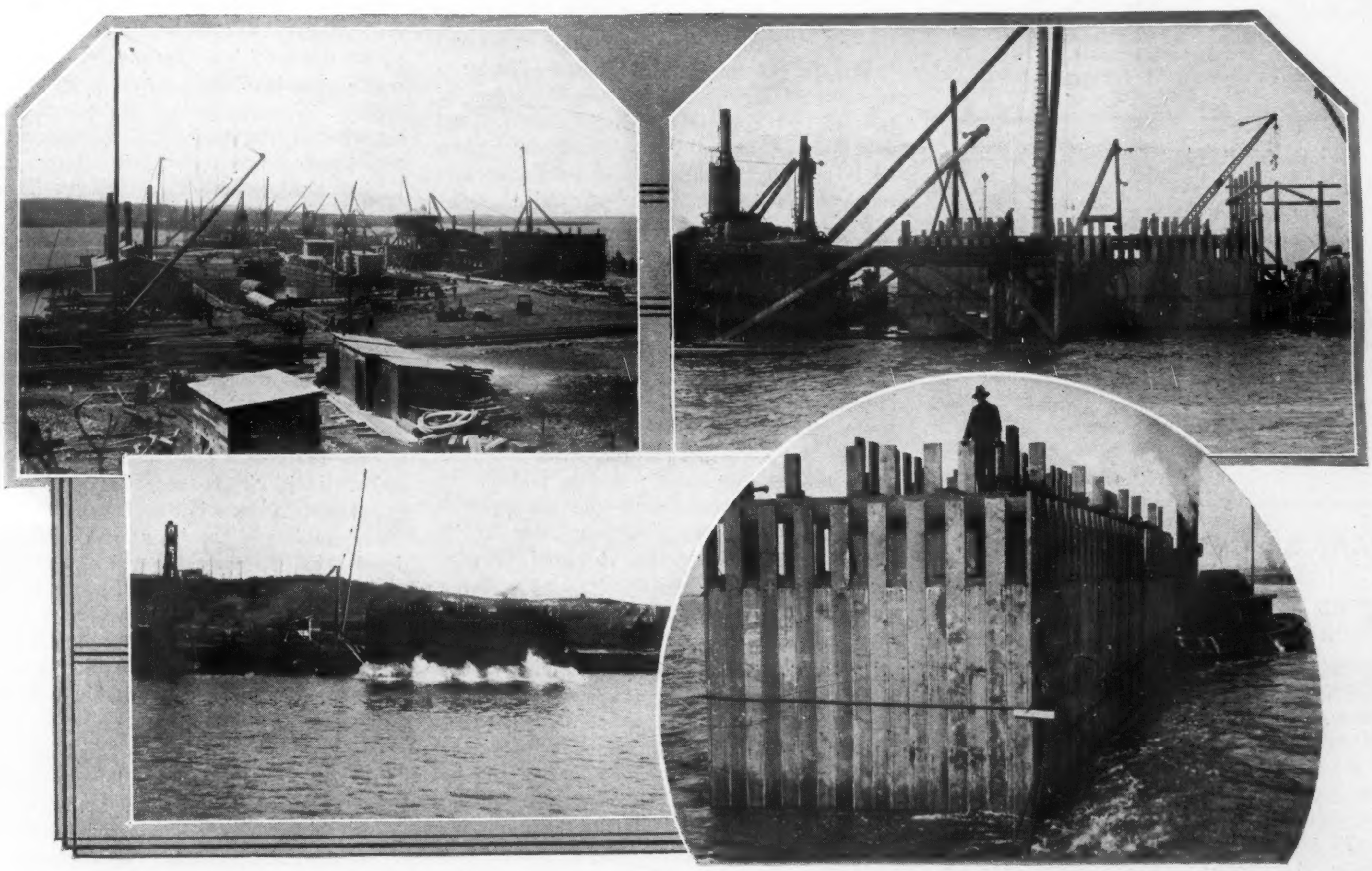
## SINKING A BRIDGE CAISSON TO A GREAT DEPTH

WITH the possible exception of a bridge in Denmark, the highway bridge now building across the Raritan River at Perth Amboy, N. J., involves the sinking of a caisson to a greater depth than any yet attained in order to get a footing on rock bottom. Certainly, it marks a record for work of this kind in the United States.

Early in May, a large caisson, or boxlike structure of heavy timbers, was launched at high tide and immediately towed to midstream, where the work of sinking it to the river bed was begun. In the bottom of the caisson there is a working chamber reached by air-locked passageways rising clear of the stream. In this chamber the sand hogs, toiling under pressure, excavate the underlying earth so that the structure can sink foot by foot until it finally settles upon solid rock. While the caisson is sinking to its ultimate resting place, workmen well above the tideway will add succeeding stories and pour into this giant mold tons and tons of concrete to make it heavy enough to force its way bottomward.

Soundings previously made by engineers indicated that the needful supporting rock would be encountered at a depth of 115 feet. This is within nine inches of the lowest point reached by any foundation placed by means of compressed air; and means that in the latter stages of the job the sand hogs must work under a pressure of 50 pounds per square inch. Near the surface of the water, where the hydrostatic pressure is moderate, the men will be on 8-hour shifts; but with increased depths the working hours will be shortened proportionately and finally cut to 2-hour periods when getting close to the bottom. Because of the nature of the work and the depths involved, a recompression or hospital lock is provided as a precautionary measure.

The Perth Amboy bridge is being constructed jointly, as a part of the Federal-aid highway system, by the State of New Jersey and the Federal Government at a cost of $4,000,000. It is to replace the present structure, near the same site, which is inadequate for the heavy traffic that averages several thousand vehicles daily. The opening of the present drawbridge, as much as thirteen times daily, has greatly inconvenienced this traffic, and for that reason the new span is to be built at a sufficient height above mean low tide so that the draw will not have to be opened more than one-third as often as is now needful. Furthermore, the length of time required for opening and closing will be appreciably reduced. The Perth Amboy bridge, which will afford one of the main outlets from New York City to the south, will require approximately two years to complete.



**Outstanding aspects of the work in connection with the launching and sinking of the caisson of the Perth Amboy Bridge across the Raritan River. This caisson will finally rest at a depth of 115 feet.**

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Application has been made by an established colliery company for permission to mine coal under the City of Sheffield, England. The coal, the best bituminous in the land, lies in two different seams; and it is proposed to work a total of 600 acres: 200 acres in one case and 400 in the other.

## BRIDGE BUILDING ACTIVE

THE business of building bridges is active with no let up in sight. The work of stringing the cables for the great span over the Delaware at Philadelphia has begun; and the same operation, but on a smaller scale, is in progress on the Bear Mountain bridge across the Hudson. The big bridge of the New York Central Railroad at Castleton is nearing completion—a fine example of rapid execution; while the piers for the new bridge of the Central Railroad of New Jersey, which is to cross Newark Bay at Bayonne, are slowly taking their places.

In a short time work will be underway upon three new bridges to span the Ohio at Portsmouth, at Cincinnati, and at Evansville, Ind. The first of these, to be built by a specially incorporated company, is for general traffic; the one at Cincinnati is being reared by the Chesapeake & Ohio for the purpose of making a direct connection with the Pennsylvania Railroad; and the Evansville bridge will be erected jointly by the States of Kentucky and Indiana, and is, incidentally, a Federal-aid project.

A much-needed and long-discussed bridge to cross the St. Lawrence and to connect the mainland with Montreal is now assured for the near future—notice having been given by the Canadian government of a resolution to empower the Montreal Harbor Commission to build, own, and maintain such a span. It is to be used for general traffic, including tramways.

# Compressed Air Magazine

*—Founded 1896—*

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*EDITORIALS*

## PANAMA CANAL GIVES ADDED PROOF OF VALUE

TEN YEARS ago, on the 15th of August, the Panama Canal was officially opened to traffic, and strife in Europe with the prospect of a prolonged struggle made the commercial value of the new waterway decidedly problematical. There were, of course, pessimists in plenty that prophesied an ever-growing figure on the debit side of the ledger, even though they reluctantly admitted that the canal might justify itself in a supreme crisis which would require the sudden defense of both our seaboards.

It should be a matter of gratification to the nation as a whole that we had farseeing men in power when it was decided to bring about the wedding of the Atlantic and the Pacific Oceans through a uniting water route across the Isthmus of Panama. Omitting seven months of 1916, during which the canal was closed to shipping because of slides, that magnificent engineering enterprise has given year by year added evidence of its value to the merchant fleets of the world.

During the fiscal year of 1914-15, vessels made 1,075 transits through the canal and yielded a total of $4,367,550 in tolls. During the fiscal year of 1918-19, there were 2,021 passages made by craft which paid in tolls an aggregate of $6,172,828. According to the figures for the fiscal year ending on June 30 of 1923, shipping traversed the canal 3,967 times and contributed $17,508,199 in tolls to the national treasury, while in the last fiscal year, ending with June just gone, commercial vessels used the canal on 5,230 occasions costing them in tolls the tidy sum of $24,290,963.54. United States Government craft made 418 transits through the canal in the same twelvemonth, and had they been charged for the privilege they would have had to pay substantially $1,106,445. The ships of trade that made the 5,230 trips carried 26,994,710 long tons of freight.

There has been a continuous growth of traffic through the canal, but this increase has been especially marked since 1919. As will be seen, transits have multiplied 486 per cent. since the first year of service, and the value in tolls during the same interval has been augmented 556 per cent. According to *The Canal Record*: "Segregating the ten years' traffic by direction, shows the traffic very evenly divided excepting as to cargo—the westbound showing a slightly larger number of transits and a slightly higher Panama Canal net tonnage, and the eastbound showing a slightly higher amount of tolls paid and more than 55 per cent. more cargo carried."

## PROBLEM OF LOWERING COST OF ROADBUILDING

RECENTLY, the Federal Forest Service allotted substantially $1,600,000 for the construction or the improvement of highways in national parks in seven of our western states. These vast and beautiful playgrounds for the people at large are visited annually by thousands of tourists; and to make these great breathing spaces accessible, the Government has wisely spent without stint in its efforts to build roads which would render transportation not only relatively easy but a well-nigh continuous source of wonderment and delight.

According to the Bureau of Public Roads of the United States Department of Agriculture, the amount of highway construction that can be done for a given amount of money varies considerably in different parts of the country and depends in the main upon the wages paid for labor. Further, we are informed by the same authoritative source that the trend of the price of the worker's service is generally upward. This in the face of the fact that there have been substantial drops in the costs of roadbuilding materials. Manifestly, the immediate problem is to find ways to reduce the charge for labor by doing mechanically as much of the work as possible.

In our current issue we tell something of what has been achieved in this direction by the Canadian National Parks Branch of the Department of the Interior. Many of the parks involved are located in the very heart of the Rocky Mountains and have called for the building of roads under extremely adverse conditions that are not unlike those encountered in some of our own national parks. Roads have been cut along the rocky faces of mountainsides and through equally difficult passes at rates of progress that would have been economically impracticable but for the use of portable compressors and air-driven rock drills of one sort or another.

What has been done in Canada is indicative of what can be accomplished elsewhere by the same labor-lightening means. This applies with equal force to roadbuilding generally, but more especially where rock is encountered in clearing the right of way. Indeed, the mobile air plant and various kinds of pneumatic tools may be of the utmost aid in speeding up highway construction as well as in lowering the cost of these increasingly vital and beneficial avenues of pleasurable and industrial intercommunication.

## RECLAIMING MILLIONS FROM THE DEEP

THE BIGGEST salvage undertaking up to date is nearing its successful conclusion. After intermittent efforts over a number of years, the British Admiralty has managed to recover nearly all the $25,000,000 worth of gold bullion which was carried to the bottom of the sea when the transatlantic liner *Laurentic* was torpedoed off Lough Swilly in January of 1917. Besides the loss of the treasure, 300 lives were sacrificed when the ship sank.

As might be expected, it was only natural that the authorities should make an effort to reclaim the bullion that lay within the strong room of the stricken craft; but it is doubtful whether the average layman can grasp the multitude of the difficulties and the character of the obstacles that had to be surmounted in venturing into the sunken vessel and in removing the golden bars from her intricate interior. It is all too easy for a diver to go astray and to drop into an unexpected pitfall when groping in the inky bowels of a foundered ship. In short, hazard and death lurk for him at well-nigh every turn and foot of advance. It is only after careful preparation and study of the structural arrangement of a craft that the underwater worker can enter and leave her with a reasonable measure of safety.

The war was still on when salvage operations were first essayed; and more than once *U*-boats appeared and drove the wreckers away. Later, Nature interfered in the form of strong tidal currents, accumulating slippery silt, and numerous large dogfish that repeatedly attacked the divers toiling far below the surface. Sudden storms added to the sum of the menaces which had to be faced from time to time. The depth to which the divers penetrated was such that, for their own well-being, it was necessary to take fully half an hour in bringing them by stages up to the deck of the salvage steamer. The task would, in all likelihood, still remain far from completion had not compressed air been available to permit the men to sink to the seabed and to labor effectively in breaking through the decks, bulkheads, etc., of the great steel craft. Air-driven tools enabled them to cut through plating with a minimum of effort and to reach their goal, which otherwise might have proved unattainable.

## WORK TO LIVE AND TO SUCCEED

MAN must work in order to live. So must the lower animals. Man is separated from the lower animals in this respect only by the things he thinks he needs and by the methods he employs to obtain them. Again, men are separated one from another by what each considers necessary to his existence and by the means adopted to satisfy his requirements. Here the accidents of birth, of education, and of environment play an all-important part, dividing mankind into groups and classes—the members of each group or class solving the absorbing problem in the manner of the particular group in which circumstances have placed them.

Never for a single day—never, perhaps, for a single waking hour, is the mind entirely free from the one compelling thought, work. There is little distinction in this respect between the rich and the poor. We all work a given number of hours each day with but one idea in mind—success. As man progresses along the social scale, as he leaves one class to enter another, his conception of necessities changes just as he changes his standing in life: he discards the conventions of one circle only to adopt those of another. His mind is now engrossed in solving the problem from a new viewpoint, and so on, should he continue to rise still higher.

The problem of life, no matter from what angle you may look at it, is a problem of work. It is natural, therefore, that one's chief interest should be in work; and to work efficiently there must be an incentive. King Alfred was the first to tell us that a day should be divided into three, 8-hour periods: one for work, one for recreation, and one for sleep. Modern society, after a lapse of many centuries, seems now to have modified this schedule. It has divided itself into two classes: those who work with their hands, and those who work with their brains. To the former, King Alfred's maxim applies, but not to the latter. Most brain workers, though they may not actually spend more than the specified number of hours "on the job," cannot entirely dissociate themselves from their work if they would succeed.

To be interested in one's work is an essential to success. It may be said, too, that an intelligent interest in one's work is almost a sure forerunner of success. World progress has been the result of this stimulus. Remove it and mediocrity will ensue.

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The history of refrigeration, so we are told, goes back to the days of the ancients. A Roman gentleman, weary of drinking warm wine, decided to experiment. He finally hit upon the idea of placing a vessel containing wine in a larger one holding water. By slowly adding saltpeter to the water and rapidly rotating the bottle in that solution he was rewarded for his pains by a cool and refreshing potation.

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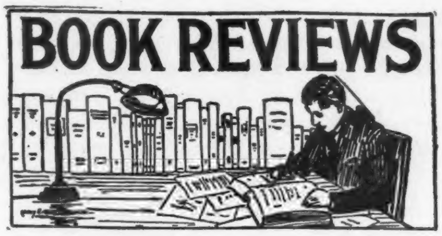
England far outranks all other foreign customers in the consumption of American canned salmon.




PUBLIC SPEAKING FOR BUSINESS MEN, by William G. Hoffman, Associate Professor of Public Speaking, Boston University, College of Business Administration. A work of 300 pages, published by McGraw-Hill Book Company, Inc., New York City. Price $2.50.

TIME was when the public speaker enjoyed his eminence more because of the way he spoke than of what he said. The spellbinder or orator—the designation is used indiscriminately by many—has a function to perform from time to time; but it is not these that the author had in mind when he undertook the preparation of the present work. His desire has been to help men of business affairs to address their fellows at conferences and at other gatherings in a way that would hold their hearers by virtue of the timeliness of the subject matter and its convincing presentation. Professor Hoffman has handled his problem well; and while a really effective speaker is more or less a natural product, the capacity to express oneself before a crowd can be greatly increased by practice and proper guidance.

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FOIBLES AND FALLACIES OF SCIENCE, by D. W. Hering, Professor Emeritus of Physics, New York University. An illustrated work of 294 pages, published by D. Van Nostrand Company, New York City. Price $2.50.

FOR a good many centuries human beings have been credulously disposed towards questionable propositions which were given a measure of scientific or near-scientific presentation. This attitude of the public at large has enabled many versatile charlatans and self-deceived persons of highly imaginative gifts to lead the populace by the nose from time to time. A clever use of technical phraseology and the coining of apt and suggestive terms have sufficed to befog the facts or fictions dealt in.

Professor Hering has taken upon him the task of bringing together in a single volume an entertaining array of the most noteworthy of the scientific vagaries which have held the attention of the world off and on for centuries. What he has to tell us is of more than passing value because these age-old fallacies of science are by no means dead and buried for keeps—every now and then one or more of them popping up, dressed in modern guise, to mislead and to tax the pocketbooks of the unwary.

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CONFLICT OF POLICIES IN ASIA, by Thomas F. Millard. A volume of 507 pages, published by The Century Company, New York City. Price $3.50.

IN HIS foreword, the author says: "The purpose of this work is to present my conception of the policy and interest of the United States in the Orient; but attitudes and policies of other nations principally concerned are also indicated, and the relation of Europe to the question." Mr. Millard is outspoken in his belief that America's interests are intimately interwoven with the future developments of the Far East. He is equally positive in his opinion that China must not be dominated by Japan lest America ultimately have to face conditions which would be to her serious disadvantage.

Whether or not the reader be disposed to accept the author's conclusions, he presents an array of facts and documentary evidence that is impressive and informative. In brief, he offers much food for thought; and his con-

## ATTUNING THE EAR TO MECHANICAL PROGRESS


From Punch

**Near-sighted old lady (who has heard of unemployed musicians playing in the streets). "Is that what you call the 'Jazz music?' I'm afraid it's a little beyond me, but here's a penny for you."**

tribution to the subject will be welcomed by students of international relations.

AMERICAN BUYERS' GUIDE, a book of 296 pages, published by The American Chamber of Commerce in Germany, Berlin. Price $3.50.

THIS volume is a classified directory and handbook for the guidance of American importers and exporters. American merchants or commercial representatives of any sort doing business in Germany are confronted at every turn by unfamiliar conditions, procedures, and laws. The purpose of the Guide is to smooth over these difficulties and to render business intercourse pleasanter and more profitable. The book should be of value to any one interested in promoting trade in that part of Europe.

*Our American System of Weights and Measures* is the title of a pamphlet recently issued by the American Institute of Weights and Measures, 115 Broadway, New York City. The purpose of the publication is really to emphasize why we should keep this system instead of adopting the metric system. The pamphlet is well written and deserving of careful consideration.

*Foreign Loans as a Trade Builder*—an address by Franklin Remington which is being distributed by the National Foreign Trade Council, India House, Hanover Square, New York City. The topic is one that very closely concerns the development of America's export trade.

## PECULIAR CARBON-MONOXIDE FATALITY

A very unusual case of carbon-monoxide asphyxiation is reported in the *Bulletin of the Royal Academy of Belgium*, and brought to our attention by the *Journal of the Franklin Institute*. Some genius in Belgium had developed an original type of excursion: parties made up of a dozen or so were taken for trips in closed omnibuses at night and not allowed to know the route or direction followed. After a journey of some miles they were released to find their way home, the earliest to arrive receiving prizes. In this case the car, equipped with a Ford motor, had about a score of contestants securely fastened inside and was under the guidance of a conductor and two assistants, riding outside.

The passengers began the journey joyously, singing and talking; but the hilarity soon ceased. Later some of the occupants hammered on the sides of the automobile—complaining of a lack of fresh air and of the heat. The persons in charge hesitated to open any part of the vehicle, suspecting merely a trick to get some idea of the neighborhood.

Upon reaching their destination, twelve of the party were found to be unconscious. Of this number, eleven recovered consciousness; but one, a lad of seventeen, died. Those who could be questioned concerning the symptoms asserted that unconsciousness developed suddenly. A *post-mortem* examination of the boy revealed conditions characteristic of carbon-monoxide poisoning.

## MAMMOTH FLOATING DOCK

THE world's largest floating dock, built by Armstrong-Whitworth & Company, Ltd., for the Southern Railway Company, has been put in commission at Southampton, England. This huge dock has an overall length of 960 feet, is 170 feet wide and 70 feet high, and is capable of lifting and accommodating a vessel of 60,000 tons displacement. The total weight of the dock, including machinery and fittings, is about 18,800 tons; and a matter of 7,500,000 holes have been drilled or punched and 3,250,000 rivets driven during its construction.

The dock is made up of seven sections—this sectional form permitting self-docking and increasing the length of the structure should that become necessary at some future day. It is equipped with very powerful electrically driven pumps; and three motor-driven air ejectors are also provided to counteract the tendency of the pumps to draw air, something that occurs towards the end of the operation of lifting a vessel.

Water is admitted into the dock by special inlet pipes with screw-down valves worked from the top deck. These inlet pipes also have flap valves which, together with the direct-lift compartment valves, are actuated by a Westinghouse electro-pneumatic valve-control system. Tables similar in shape to the dock are fitted in the valve house, and the slides for operating the various valves are placed in divisions in these tables that correspond to the positions of the actual water-tight divisions which the valves control. These valve slides are worked pneumatically; and adjacent to each slide is an indicator that shows the depth of water in its associate compartment.

A small electrically driven air compressor and a receiver are installed on each wall of the dock for supplying operative air for the valve-control system. Two rows of air lines have been run along each side wall, and these are fitted at suitable intervals with air cocks to which flexible hose can be attached for the purpose of furnishing compressed air to pneumatic riveters, rivet busters, chippers, and pneumatic drills, now so universally used in the construction and repair of steel vessels.

Eight electrically driven side shores, each 63 feet long, are secured to the dock—opposing pairs being geared together and driven by one motor so that the ship can be automatically centered. These shores have a 2-speed movement; and there is a centering device that indicates whether or not a vessel is in proper position before lifting is commenced. Four mooring booms, each 110 feet long, connect the dock to the shore, where they are held by a reinforced-concrete dolphin. The dock is, of course, provided with all the necessary tools and equipment required for overhauling and repairing ships.

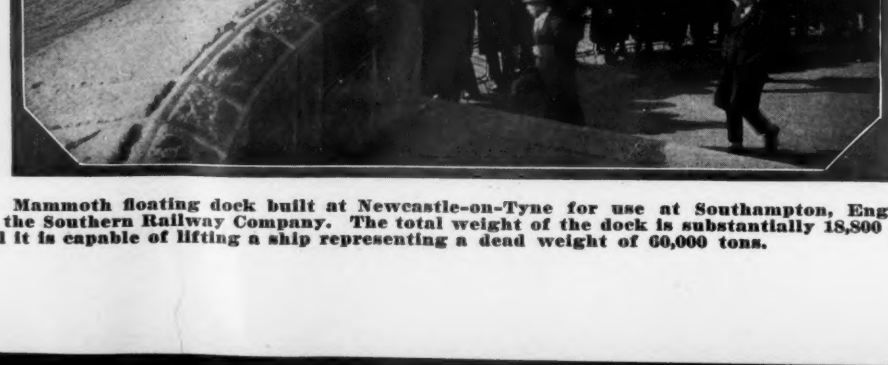
## REQUIESCAT IN PACE

THE following affecting obituary notice will be read by few without some spasm of emotion. As it has come to us at second or maybe third hand, we cannot give definite credit.

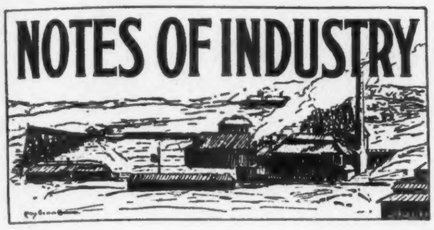
In the dead of night, a big steam shovel, tired of its endless labors, plunged headlong 500 feet over a precipice to a watery grave in the Pacific Ocean. A *post mortem* investigation showed that about four feet of bank gave way, allowing the deceased to slide away suddenly.

The shovel hit only three times in its descent; and the last plunge, from a cliff about 150 feet high, landed it 75 feet away in the sea. The operator escaped. No services were held, as the mourners could not be assembled; and she now rests on the bosom of the Pacific free from all earthly troubles. The remains may be seen at low tide. No effort is to be made to recover the body.

Basing the calculations on the latest available census, which gives the total population of Italy as 36,204,182, at least 8,585,683 of her inhabitants—about 24 per cent., do not enjoy the use of electricity. However, the construction of new electric power plants is proceeding rapidly in that country; and the opinion is expressed that within six or seven years it will be possible to satisfy double the present demand.



**Mammoth floating dock built at Newcastle-on-Tyne for use at Southampton, England, by the Southern Railway Company. The total weight of the dock is substantially 18,800 tons, and it is capable of lifting a ship representing a dead weight of 60,000 tons.**




That the world is turning more and more to motor ships is brought out by the fact that nearly a third of all the tonnage now under construction consists of vessels of this type.

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The use of refrigerator cars, first pointed out as being practicable by the American Expeditionary Forces, is gradually increasing in France. During 1923, a total of 869,000 hundredweight of produce was carried in cars of this sort, operated by the French Refrigerator Car Company, as compared with 541,000 hundredweight in 1922. This increased traffic indicates, so we are told, that the prejudice in that country against cold-storage meat is being overcome. A large part of the equipment now in service was used by the American Expeditionary Forces.

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American goods to the value of about $2,000,000 are now being shipped abroad each month by parcel post. These figures are encouraging, and prove that the American business man is at last viewing foreign trade in its true light—as "long-distance selling."

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The famous California quicksilver mine, located in Santa Clara County near San Jose, recently celebrated its hundredth anniversary. It is from this mine that Indians are said to have procured their war paint a century ago. Since its inception, quicksilver to a total value of $75,000,000 has been obtained.

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American goods are very popular in Australia. According to the latest of our foreign-trade figures, the greatest increase occurred in exports of refrigerating and ice-making equipment, which rose from a total value of $37,661 in 1922 to $105,761 worth in 1923. Considerable expansion was also noted in the market for American air compressors. Machines of this type shipped to the antipodes in 1923 were valued at $343,508 as against $72,483 in 1922—a growth of 21 per cent.

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According to official estimates, Denmark has nearly trebled her consumption of sugar within the last 30 years.

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United States growers produce 35 per cent. of the world's tobacco crop, which amounts to 4,000,000,000 pounds annually.

If China had as many telephones per capita as the United States, the number would total 100,000,000. As it is she has but 75,000 against our 25,000,000.

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France is now obtaining a total of 2,400,000 H.P. from her hydro-electric developments, not including those begun in 1924.

## COPPER LENGTHENS LIFE OF STEEL

THE Baltimore & Ohio Railroad still uses some small and virtually obsolete wooden cars that were constructed in its Mont Clare shops during the Civil War period. In repairing these cars it was observed that while the wood has had to be replaced the metal parts remained in good condition despite the fact that they were not protected by paint.

As a result, a piece of the iron was sent to a laboratory for analysis, and it was revealed that the metal utilized by the Baltimore & Ohio back in 1862 contained a small percentage of copper. Further investigations led to the employment of copper-bearing steel for similar parts on modern cars. This alloy is expected to give much longer service than the metal it has replaced.

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## DINNER PARTY ON SHOULDER OF LEE'S STATUE

THE FIGURE of a man of such gigantic size that fourteen people can comfortably dine on its shoulder is something to stagger the imagination.

Such, however, are the proportions of the statue of General Robert E. Lee in the magnificent Confederate memorial, previously described in the Magazine, which is being carved on the solid-granite face of Stone Mountain.

It has been said of the head of Lee, which was unveiled early this year—in fact on his birthday—that it is the greatest portrait ever cut in stone not only in the matter of size but, likewise, in faithfulness of resemblance. The full figure of General Lee—which is but one of six others of similar dimensions in the central group—will be 165 feet high from the crown of his hat to his horse's hoofs. However, a better grasp can be had of its immensity when it is realized that the statue will stand as high as a 15-story office building.

**Guests at a dinner party given by the sculptor and his wife upon the granite shoulder of General Lee's heroic figure.**

The sculptor, Gutzon Borglum, and his wife recently entertained distinguished guests on the ledge of granite which will form Lee's shoulder. This ledge has been channeled out of the perpendicular face of the rock some 700 feet above the surrounding terrain.

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Something new in devices to harness the sun's rays was tried out not long ago in San Francisco, Cal. This solar furnace, we are told, was capable of actually melting a piece of building brick within two or three seconds—although there was a fog and the sun was partly obscured by clouds—by merely focusing the sun's rays. The apparatus, a modified burning glass, consists mainly of a series of 22 mirrors and 23 magnifying lenses which, when turned against the sun's rays, concentrate the heat at a given point.

**Gutzon Borglum putting the finishing touches on Lee's nose.**